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THE LATE HUMBERT I., KING OF ITALY.

KING HUMBERT.

KING HUMBERT was assassinated at Monza, Italy, on July 30 by an anarchist named Bresci. The King was struck by three shots from a revolver fired by the murderer. The assassin was arrested and was with difficulty saved from the fury of the populace. The Prince and Princess of Naples, the heir apparent to the throne and his princess, Helene of Montenegro, were at once summoned to return.

King Humbert was the eldest son of King Victor Emmanuel II. and of Adelaide, Archduchess of Turin. He was born in Turin on March 14, 1844, and was christened Renier Charles Emmanuel Jean Marie Ferdinand Eugene. On ascending the throne, in 1878, he took the title of Humbert I., in Italian Umberto.

Prince Humbert was early initiated in political and military affairs by his father, with whom he was associated in the war for Italian independence, although he was too young to take an active part in this important struggle. In the movement for the unification of Italy, which succeeded the events of 1859, he had a more important share and in especial he was active in the work of reorganizing the ancient Kingdom of the Two Sicilies. He visited Naples and Palermo in July, 1863, and shared with Garibaldi the enthusiasm of the populace.

When the war between Prussia and Austria was threatened, he was sent to Paris to discover the views of the French Government in regard to the proposed alliance between Italy and Prussia. When hostilities began Prince Humbert hastened to enter active service, and was placed in command of a division under General Cialdini, with the title of Lieutenant-General. He was present at the disastrous battle of Custozza, on June 23, 1866, where he is reported to have performed prodigies of valor.

Prince Humbert was married to his cousin german, the Princess Marguerite Marie Thérèse Jeanne of Savoy, daughter of his uncle, the Duke Ferdinand of Genoa, his father's brother, on April 22, 1868. After the occupation of Rome by the Italian troops in 1870, Prince Humbert and the Princess Marguerite went to live in that city.

On the death of King Victor Emmanuel II. on January 9, 1878, King Humbert succeeded his father. The first attempt to assassinate him was made on November 17 of the same year. As he was entering Naples Giovanni Passananto approached his carriage and attempted to stab him with a poniard. The King received only a slight scratch, but the Prime Minister, Signor Carroli, who was with him, was badly wounded in the thigh. The assassin was condemned to die, but the King commuted the sentence to penal servitude for life.

The second attempt to end the life of King Humbert was made on April 22, 1897. He was driving to the Campanelle racecourse, when a workman struck at him with a dagger. The blow was turned aside, and the man was caught and condemned to life imprisonment.

King Humbert and Queen Marguerite celebrated their silver wedding in Rome in April, 1893. Their only son, born in Naples on November 11, 1869, Victor Emmanuel Ferdinand Mary Jannarius, who bore the title of Prince of Naples, was married in October, 1896, to the Princess Helene, of Montenegro.

King Humbert was a man of mild manners and kindly disposition, and was beloved personally and respected by the Italians. He had been in feeble health, it is said, for years. He was tall and of striking appearance, with a fierce snow-white mustache and white hair, which he wore in pompadour Italian fashion.

The reign of King Humbert was marked by a number of happenings which had a bearing on the development of the kingdom and its foreign relations.

Italy, in the early years of King Humbert's sway, was desirous of taking an active part in European affairs. Through its premiers the country declared that it wished to live in peace with neighboring nations on condition of being one of the great Powers. Whether on account of jealousy or defiance of France, or whether to obtain for itself the strongest support, the Italian government was brought into close relations with Germany and Austria and with England, taking its cue for colonial expansion from the latter, especially under Crispi's ministry. The Triple Alliance formed by Germany and Austria against France was completed in 1891 by the accession of Italy, in which she undertook to keep up a vast standing army and a great navy far beyond the country's means, draining its treasury and oppressing the people by onerous and heavy taxes.

In January, 1885, Italy undertook to co-operate with the English against the Mahdi, the Italian troops occupying Massowah, on the Red Sea. The Government, having secured this unimportant territory, declared its intention of following in the steps of the great powers in colonial expansion. In spite of the great financial burdens imposed by this expedition and the sacrifices made of men and money, reverses in 1887 and in 1888, when the Italian troops were defeated by the Mahdi, provoked opposition to the colonial policy at home, the Italian possessions on the Red Sea were constituted the Erythrean Colony by a royal decree promulgated in 1890.

Italy's misfortunes were commercial at this time, rather than political. Her exports were reduced in 1888 by the Government's refusal to renew the commercial treaty with France which had gone into effect in 1881. Between 1880 and 1884 the state of Italy's finances improved, and March 1, 1893, the Ministry was able to resume specie payments. Since then great military and naval expenses have caused frequent deficits in the budget, and the difficulty of meeting them has been one of the chief difficulties of Italian statesmen and the cause of many changes of Ministry.

The relations between the Italian Government and the Vatican were a constant cause of unrest during King Humbert's reign. The Government was always trying to respect its guarantees to the Pope, while the latter has been protesting that the situation forced upon him at Rome no longer offered him security.

King Humbert's relations with the heads of foreign States was friendly. In 1884 his personal courage was shown by a visit to the plague hospitals of Naples at the time of the cholera epidemic. His conduct in speaking to the patients increased his popularity.

Victor Emmanuel Ferdinand Mary Jannarius, who succeeds to the throne of Italy as a result of the assassination of King Humbert, his father, was born on Nov. 11, 1869. As a child the Prince of Naples was weak and ailing. An English nurse did much to bring the boy around to good health, although he never was robust. His mother, who is more than half German, insisted on the educational methods of that country being applied to her child, whose intellect, being naturally bright and quick, but not of the massive order, was ground down instead of being improved by his studies. Modern languages (French, English, German), Latin and Greek, mathematics, philosophy, military history, kept him continually at his desk, nor could he play truant, for his tutor or keeper, Colonel Oslo, cold and inflexible, was always on duty, and did not allow his ward a minute's freedom. At last the Prince's health suffered to such an extent that King Humbert, becoming alarmed, determined that the mode of life led by his only son should undergo a complete change. He appointed Colonel Oslo to the command of a regiment, dismissed all the other pedagogic torturers and sent the Crown Prince traveling throughout Europe—to Germany, England, Greece—and to the East. When he returned the Prince of Naples had in a certain measure recovered his health; but he had lost his only chance of conquering rickets during infancy, and even now he is obliged to sustain the trunk of the body, out of all proportion to his legs, by means of a steel corset.

The Prince was not allowed in his boyhood to have much spending money. Indeed, the enormous debts left by King Victor Emmanuel made it necessary for King Humbert to exercise the utmost economy. But the little fellow used his small allowance to the best advantage. He never squandered it, and seldom bought toys for himself, but saved his money until it reached a considerable amount, and then purchased something of permanent value, more often for some one else than for himself. One day he astonished his mother by asking her how much a silk dress would cost. She told him, whereupon he said: "I haven't quite so much as that, but if you'll let me go out alone and on foot some morning I think I can go to some shop where they won't know me and get one. I want to give it to my nurse. Her best gown is really very shabby!"

No Prince of Europe had so much difficulty in finding a bride as he. He traveled from one court to another in the vain search for a young woman willing to share with him his future throne. But for a long time he laid his coming crown at the feet of various princesses of the blood in vain. The Prince is below the medium height and of delicate build, and altogether of an appearance not calculated to inspire the love of a woman. Unfortunately for him, he did not inherit the facial beauty of his lovely mother, Queen Marguerite, long considered the handsomest Princess in Europe. Neither did he fall heir to the rugged, attractive features of his kind, bluff father. To the regret of the King and Queen, their son was for years so backward and bashful that it was almost impossible to induce him to attend even a court reception. He appeared to be afraid of every woman.

When he was sent to join a regiment stationed at Naples he seemed to overcome his aversion to the fair sex, and soon started on a bride-hunting tour. For a time it was said that the future Queen would be a daughter of the house of Orleans, but this supposition proved to be unfounded. Greek and Russian princesses were mentioned in turn, and then came the visit to the court of Berlin, where he was received with great distinction, and the rumor was that the sharer of his future throne was to be a relative of the German Empress. But the young woman, according to gossip in Germany at the time, exercised a right which princesses of reigning houses seldom assume, and declined to entrust her happiness to the Savoy heir under any conditions. The Prince, to the great chagrin of his father and mother, was obliged to return home and again resume the reading of the Almanach de Gotha for a suitable mate.

His military career was remarkably rapid, as is generally the case with officers in his exalted station, but he was obliged to undergo stiff examinations on being promoted, the only difference between himself and others being that he had not to wait for the usual time to elapse between one promotion and another. When in command of the military division of Naples, the Crown Prince was a constant guest at the tables of the

HELENE, QUEEN OF ITALY.

VICTOR-EMMANUEL III, KING OF ITALY.

Bourbon aristocracy, and on more than one occasion, it appears, the "belles Napolitaines" succeeded in capturing his heart. This little weakness, hereditary in the house of Savoy, caused his transfer to Florence, the artistic capital of Italy, which inspired the young general with more refined tastes and higher aspirations. Since his childhood his chief hobby had been numismatics, and his collection of mediæval coins is considered one of the finest in Europe.

An English correspondent at Rome in 1890 thus writes of the twenty-first birthday of the Prince:

"The Prince of Naples completed his twenty-first year yesterday, and this fact makes him a member of the Senate. All the public buildings and several private houses hoisted the national flag in honor of the event, and there was music in the Piazza Colonna, but there were no illuminations like those in London on the Prince of Wales' birthday, although the royal family of Italy is quite as popular with Italians as is the royal family of England with the English. The Prince of Naples, however, is perhaps a little too sedate for his age, and is altogether a different type from the genial Prince of Wales. The young Prince of Naples is essentially a student, with a philosophical bent, and more like his great grandfather, Charles Albert, than any other member of the family. Like the King, the young Prince rarely smiles. To be sure, the Queen smiles enough for all three. The Prince of Naples cannot fail to be respected and revered by Italians, but I doubt if he will ever be as popular with all classes as the Prince of Wales has been all through his life.

"The Prince of Naples may have none of the Prince of Wales's heartiness, but perhaps his very prudence and circumspection render him colder looking than in reality he is. In any case, no one can deny that he is a worthy son of his father, and, like his father, will strictly perform his duty to the country if ever he is called upon to succeed him. The King has declined to ask Parliament for an allowance for his son. He provides for him himself, and, from yesterday, allows him 500,000 francs a year. The Royal Palace in Naples is being prepared for the Prince, who will henceforth make Naples his chief residence, much to the delight of Neapolitans, and to the envy of all who know that enchanting spot."

It was said of the Prince of Naples that he was likely to be much more of a "domesticated husband" than his father has been, or than his grandfather was. He is enamored with a soldier's life, with sport, and with all the fashionable amusements of the day. He is an uncertain quantity in Italian politics. Up to the present time he has had nothing to do but to receive the usual princely education and to live in an ornamental way. He is, to be sure, a general in the army, but in times of peace one does not become a general in the army through sheer merit at the age of twenty-five, as the Prince did. The new King is a good-hearted fellow, like his father, not quite so generous, perhaps; and he has not shown, possibly because he has had no great opportunity to show, that he inherits the tremendous will power of his grandsire and namesake, Victor Emmanuel II. Between the Prince and his mother there is the closest affection.

He has been a great favorite throughout Italy, for he inherits from his beautiful mother all her intellectual strength and delight in the pursuit of knowledge, while his military distinction and great bravery in circumstances of personal danger descend to him from his valiant father. He has received an education rarely bestowed even upon an heir apparent, and has well profited by it, possessing one of the most serious and cultivated minds among the princes of his generation. His tutors speak of his application with words of high praise. Besides this, he is quite an encyclopedia of Italian history, art and literature.

In August, 1896, the engagement of the Prince of Naples to the Princess Helene of Montenegro was announced.

The Princess was born January 8, 1873. She is beautiful, of fine physique, highly educated, and was not accustomed to luxury or even to much comfort before her marriage. In fact, she hardly knew what it was to have pin money or a wardrobe allowance. She was brought up in the style of the Highland chieftain's daughter of the last century. It was announced at one time that she was engaged to King Milan of Servia.

She is known as being fond of horses and a good shot. She has had a most careful education, speaking French, German, Italian, and English. One of her sisters married the Russian Grand Duke, Peter Nicolaivitch, and another wedded Prince George of Leuchtenberg. The wedding of the Prince of Naples and Princess Helene took place in October, 1896, at Rome. The marriage was celebrated in two places, the civil ceremony being performed in the Royal Palace of the Quirnal and the religious ceremony in the Church of Santa Maria Degil Angeli. No offspring has blessed the match.

General Draper, the American Ambassador to Italy, is quoted as being much impressed with the unusual ability of the new King, and William Potter, the former Minister, has also spoken in high praise of him.

For our engravings we are indebted to L'Illustration and for our biographies to The New York Tribune.

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AMERICAN ENGINEERING COMPETITION.*

VI.—MANUFACTURE OF STEEL—I.

THE coke-making region for the Pittsburg district is at Connellsville. This gives about a 50 mile haul, so that the Americans have no advantage over many of our blast furnaces in regard to geographical position, but rather the reverse. The coke is said to be as good as our best blast furnace coke, and is certainly a strong fuel suited to bear the heavy burden of the American furnaces, though it has, perhaps, hardly the beautiful silky appearance of our own best Durham coke.

When the materials for the blast furnace have arrived at the works there is as great a difference in the method of handling, compared with English practice, as there was in transport. At the Duquesne works of the Carnegie Company there are, as already stated, four furnaces, each producing the enormous output of 600 tons of iron per day of 24 hours; indeed, they have been worked considerably higher, even up to 700 tons. These furnaces are placed in line and are flanked by the big stoves for heating the blast; the latter even forming a more conspicuous feature than the furnaces.

The system of ore handling followed may be described as a combination of the shipping arrangements at Duluth and the landing arrangements at Lorain, both of which have been described. At the front of the furnaces is a large stock yard, where the heaps of ore are piled. Between the furnaces and the stock yard are two parallel trestles or railway viaducts, the upper parts of which are divided up into lockers or bins in the same way as the jetties at Duluth. The viaduct nearer the furnaces is used for coke and limestone; that farther away forms the iron ore store for immediate use. There are 62 ore bins, each holding 150 tons. The mineral trains are drawn on to the viaducts and deposit their load into the lockers or bins beneath. From the bins the ore, coke and limestone are allowed to fall into buckets carried on trucks on lines laid on the ground level, and in this way are conveyed to a steep inclined frame or trolley way, which is an openwork steel structure and extends from the ground to above the top of the blast furnace. From the trolley that runs up and down this inclined way is suspended the bucket carrying the materials for the blast furnace. The trolley and bucket being drawn up by a wire rope, actuated by a hoisting engine, the whole is lifted up until the bucket is suspended above the top of the furnace. The bottom of the bucket is then made to open, and the contents fall into a large receiver, whence they are allowed to drop into the furnace when a sufficient charge has accumulated. There is a compressed air engine on the top of the furnace for working the "bell" which closes the mouth of the furnace.

These operations are carried out wholly by mechanical means, the blast furnace materials not being "handled," in the proper acceptation of the term, from first to last. Thus they fall through the bottoms of the receiving wagons into the bins, and from the bins into the buckets. The buckets are then drawn by locomotives to the inclined trolley ways, a hook on the trolley seizes the bucket and conveys it to a point above the top of a furnace, the charge of the bucket falls into the receiver, and, lastly, the receiver opens to put the charge into the furnace—all by mechanical means. There are absolutely no men on the top of the furnace, and no crowd of laborers below. The whole of the operations of hoisting and charging are performed by one man who sits in the cabin where the hoisting engine is 100 feet away. How different all this is to the older system of platform hoists and hand barrows, with the attendant jostling crowd, need hardly be pointed out. Naturally the new plan entails large initial outlay, but the American blast furnace manager founds his practice on the view that capital is cheap but labor is dear; and he never hesitates to debit his working expenses a hundred dollars for additional capital if he can credit a hundred and ten or twenty or fifty, or two hundred may be, in labor saved; and he allows no trade union to say him nay.

The procedure here described is that followed when working the furnaces with material directly as it comes in. But, in order to provide ore to keep the furnaces in blast when the lakes are frozen, the stock yard is provided. To distribute the ore over the wide area of the yard, and also to take it to the blast furnace, there are at Duquesne four conveyers or Brown bridge traveling cranes, which stretch over the stock yard and command every part. They have a span between uprights of 240 feet, and the overhang is 30 feet. The bridge is supported at the back by a steel structure which contains the engine house, where the motive machinery is placed. This, like the iron supports, runs on rails, so that the whole—bridge, piers, and engine-house—may be traversed longitudinally. As the trolley with the bucket attached runs transversely on the bridge, the whole of the big stock yard is commanded by the four bridges. The enormous stocks of ore that accumulate at the beginning of the winter season are quite geographical in appearance, being piled up like a miniature mountain range, with sharp peaks and deep valleys in most picturesque formation. When it is desired to transfer the ore to the furnaces again no human intervention is needed beyond that of the man in the cabin, who actuates the electrical motive machinery. The skip or bucket is lowered on to the side of the pile and scrapes itself full automatically. It is then raised to the needed height and swung along, in midair, beneath the bridge to the position required, so that the ore can be transferred to the bogies and taken to the furnace top in the manner already described.

To follow the various processes of manufacture of steel as pursued in America would be both interesting and instructive, but would need a treatise rather than an article. Although it is quite impossible to deal with these matters in detail, a few notes may be added on points that seem more particularly remarkable.

In dealing with the blast furnace itself there are two features to which reference may be made, though they are not altogether new. The first is the steam gun, and the second the pig casting machine. The former is used for stopping the tapping hole of the furnace. It will be understood that, as the metallic iron is smelted or separated from the gangue, or dross of the ore, the molten metal drips down and collects in a mass on the bottom of the furnace. There is a hole known as the tapping hole; and this is stopped with clay, which has to be rammed in very hard to keep the heavy pool of liquid metal confined. When the furnace is tapped the clay is broken out by crowbars and picks, very trying and arduous labor. The Americans, with their traditional dislike to heavy work, have devised a steam gun for the purpose. It is a simple apparatus consisting of a single-acting steam cylinder having a piston with a rammer attached. In front is another cylinder into which large balls of clay are placed. The apparatus being brought to position and steam turned on, the gun will fill the tapping hole in two or three minutes more effectually than could be done by hand in half an hour. The "clay gun" is looked on as so essential at Duquesne that it is doubted whether the heavy burdens, frequent tappings, and high blast pressure there in vogue could well be maintained without its use. It takes two men to work this gun.

The product of the four blast furnaces at Duquesne is partly used in the Duquesne mills and partly at the Homestead works, four miles away. In the latter case the molten metal is run from the furnaces into bogie trucks carrying ladles holding 16 or 17 tons of white hot metal. About seven are generally coupled up to the locomotive; and it is well to stand clear of the train as it jolts over points and crossings if the ladles happen to be extra full, for a slop over of liquid iron is not a pleasant thing to encounter. A loaded train of ladles or of slag bogies is an interesting and, to a stranger, a rather startling sight. Of course, it is common in the iron and steel districts of Great Britain, where "direct metal" has been used for years past.

In explanation of the term "direct metal," it may be said that the original method of operating a Bessemer converter was to take pig iron and melt it in a cupola, the molten metal being then transferred to the converters and "blown" according to the method introduced by the late Sir Henry Bessemer. This necessitated an extra expenditure of fuel, and naturally it was soon perceived that it would be cheaper not to let the iron get cold, but to use it at once direct from the blast furnace. The smaller scale on which operations were formerly carried on, and various difficulties, real, imaginary, or exaggerated, prevented this plan being followed for some time; but the perfection of mechanical appliances in the steel works has enabled the system to be carried out with advantage. The danger of the mass of iron cooling in the ladle sufficiently to prevent it pouring out was at one time thought formidable, but such a contingency is really very remote. I remember a case in South Wales of the locomotive getting off the lines. After considerable delay it was put back and drew the bogies to the converter house, at the other end of a long valley, where the metal was duly made into steel. The Carnegie Company were, at the time of my visit to Homestead, about to build blast furnaces on the opposite side of the Monongahela River to supply the works with molten iron for steel-making. The river here is about as wide as the Thames at London Bridge, and the company will build a special railway bridge to carry the molten metal across. These new furnaces will have a bigger output than even the Duquesne furnaces, being rated at 700 tons a day. This will, no doubt, be largely exceeded at times, if we may judge by past experience, so that each furnace will probably produce in a day as much as good-sized blast furnaces a few years ago (and many now existing) would turn out in a week.

A great deal of the metal from American furnaces is, however, cast into pig iron, and here we find a notable figure in operation. Pig iron is ordinarily cast on the pig bed, which is a level expanse of sand in front of the furnace. This has a certain number of shallow channels in it, and branching from the channels are short blind ditches or moulds. The channels are known as "sows" and the blind ditches as "pigs." The molten metal fills the sows and pig moulds, and, when cold, has only to be broken up to form the well-known pig iron of commerce. This is the time-honored method of making pig that has been handed down to us by our forefathers from generation to generation. It has several defects. In the first place, a good deal of sand adheres to the metal. This is not a drawback in the eyes of the ironmaker, for sand is cheaper than iron, and the more sand adhering the more the profit. From the user's point of view, sand is not a good thing to have in the cupola, both for commercial and chemical reasons.

There are one or two forms of casting machines. At the Duquesne furnaces the Uehling machine is used. With this the molten metal is run into cast iron moulds strung together in a continuous chain. These are caused to travel along by means of an engine, each in turn being brought under the running stream of melted iron, and finally the pigs, when cooled, are transferred to the railway cars. Here, again, the operations are carried out by mechanical means, the great virtue of the apparatus being that it saves labor. We have casting machines in England, notably one devised by Mr. R. H. Wainford, of Stoke-on-Trent, but machine casting has met with a good deal of opposition in this country. There is, first, the objection of the ironmakers that if their pigs are all iron and no sand the profit is less, though this drawback is never more than whispered among themselves. But it is openly said that purchasers will not often pay the difference in price to compensate for the cost of purer material. Again, casting in iron moulds, or "chills," alters the appearance of the "fracture"; and, as iron is largely bought by the fracture, chilled pigs may not be readily salable, though chemical analysis might show them to be really everything desirable. All this, however, is beside the mark when the iron is used for steel-making and is not sold as iron. In that case the appearance of the "fracture" is not of any consequence, and the full advantage of machine casting is obtained.

It is said that the cost of labor when the casting machine is used is about ten cents per ton. Three men per shift are able to attend to a machine having a capacity of 1,500 tons of pig per twenty-four hours. To set against this advantage there is the somewhat heavy first cost of the apparatus. Therefore, present sacrifice has to be made to get a future gain; but those interested state that the saving in labor gives a very handsome return for the outlay of capital. Work on the ordinary pig bed is of an especially trying nature, and, if only in the name of humanity, should be done away with if possible.

Leaving out, for want of space, several details peculiar to American practice, I will pass on to the charging floor of the steel furnaces. An open-hearth, or Siemens-Martin, furnace in its many forms has much the outward appearance of a gigantic baker's oven well strapped with iron buckstaves. There is an iron door, and through this, when open, may be seen, on the hollowed refractory floor of the furnace, a pool of bubbling molten metal of forty to fifty tons, brought to so intense a heat that the eye can no more look at it than on the noonday sun. The particular row of furnaces I have in mind is one of the sets at the Homestead Works. There are twenty altogether, and they were commenced about two years ago, when ten 47-ton

* This series of articles on American Industries was written by an expert of The London Times, who made an extensive trip through this country in order to prepare the articles, the first of the series being published in the SUPPLEMENT of July 21.

furnaces (actual) were erected. After only one year had elapsed ten more furnaces were built of rather larger capacity, working 50-ton charges. At the time of my visit four more of the larger size were in progress, making twenty-four in all; but further ones were shortly to be added. This instance of rapid progress by no means stands alone; it is typical.

The materials used for producing the mild steel—pig iron, scrap, and ore—are taken from the railway wagons by electric traveling cranes, and placed in iron charging boxes or trough, which are carried on small trucks. These boxes form part of a very ingenious machine which constitutes a leading feature in a good many steel plants of America. This is known as the Wellman-Seaver charging machine. It is one of the most important of the labor-saving appliances used in the United States steel-works. The charging platform of a battery of open-hearth furnaces has rails laid on it running parallel with the row of furnaces. Upon these the charging machine is traversed on its wheels so as to command each furnace door in turn. The machine consists essentially of a strong platform and framework, upon which are the charging mechanism and the electrical motors that perform all operations. The machine is traversed on its rails until it is opposite to the charging door of the furnace, the charging box on its bogie being between the furnace and the machine. The operator, seated on the machine simply by turning an electrical switch, causes a strong steel arm or charging bar to be thrust forward. This grasps the charging box, pushes it bodily through the open door into the glowing furnace, and, turning it over, spills the contents into the pool of seething metal—or bath, as it is technically called. As the furnace doors are opened by hydraulic means, and as the bogies carrying the charging boxes are also moved by the machine, no labor is needed beyond that of the attendant who puts the mechanism into action. A charge of half a ton is placed in the furnace with almost incredible smoothness and swiftness, a few seconds being quite sufficient for the purpose.

This is the new way of charging an openhearth furnace. The old way (which is largely the present way) is exactly that which would have been followed by Adam, or by Tubal Cain, if he had had a furnace to charge. The Wellman-Seaver machine is an advance at a stride. It carries us from the most primitive form of labor to that of a wonderfully-organized apparatus, actuated by the subtle power of which we now hear so much and have learned so little, but which we know is destined to relieve humanity of a great part of the drudgery of civilization. By machinery of this kind men are set free to exercise those higher gifts which are the common heritage of all, but which are too often submerged by continuous labor of an arduous nature carried out under distressing conditions.

CREUSOT GUNS ON DISAPPEARING CARRIAGES.

15-Centimeter (5·905-inch) 26-Caliber Gun, on Disappearing Carriage—

Weight of gun	2,750 kilos.	(6,061 lb.)
" mounting	6,500 "	(14,326 ")
" projectile	35 "	77 ")
Muzzle velocity with black powder	520 m.	(1,706 ft.)
Elevation	+15°—5°	
Training, through	360°	

The gun is a general type of Schneider-Canet ordnance for garrison armament. The breech-block opens in three actions, and is fitted with a plastic obturator. The bedplate is provided with a roller-path, the balls of which are maintained at a fixed distance apart by a circular plate-ring, in which are cut a series of hollows. It is fitted with a circular disk for fixing it to the foundations. The slide consists mainly of two vertical brackets, joined at their lower part by a circular platform which revolves on a set of balls on the bedplate. A clamp holds the rim of the latter and the front of the slide, preventing all shifting when the gun is fired. The beam, in which the gun trunnions are placed, consists of two cheeks stayed together at the top; it is movable round a horizontal axis formed by two hollow drums, which oscillate in vertical brackets fixed on the platform of the slide. The gun is, moreover, supported in front of its trunnions by two jointed rods on a collar placed near the wedge coil. The rods oscillate at their lower part on a shaft supported by two sliding shoes, which fit in circular grooves made in the front of the slide brackets. Two smaller rods join the shoes to these arms; these are in a line with the cheeks, below the drums. The hydraulic recoil cylinder is movable; it is placed horizontally between the brackets, and is provided in front and in the rear with two cross-bars that travel in gun-metal guides fitted to the slide. The piston remains fixed; it consists of a cylindrical rod hollowed out along its length, the central counter-rod being held on the bottom of the recoil cylinder. The recuperator is formed of two hollow drums, round which the beam turns. The bottom of each drum is in communication with the recoil cylinder through a pipe fitted with a loaded valve. In the valve seat are two narrow vents which cross at right angles; these openings can be closed wholly or in part by a conical-pointed rod worked by a screw. This establishes a direct passage, the area of which can be made to vary at will, though the valve be fallen back on its seat. The other end of the drums can be put in connection with an air compressor, worked by hand or by power; a movable airtight diaphragm is put in both cylinders, between the liquid from the recoil cylinder, and the compressed air delivered by the compressor.

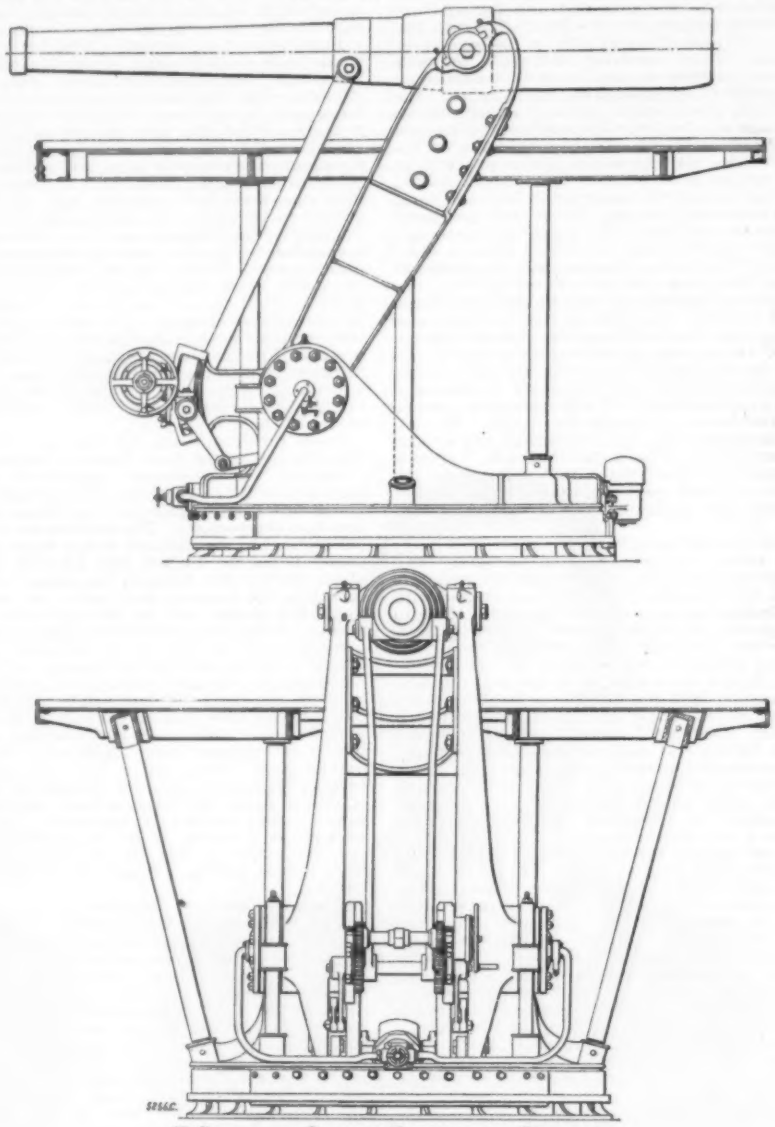
When the gun is run up and ready for firing, the pointed regulating rod is screwed down, closing the vents. Then, when the gun is fired, the recoil causes the beam to turn round the drums, and the arms fitted to the lower part of the beam cheeks are driven forward, drawing with them the recoil cylinder in which the piston enters. Pressure is thus exercised on the liquid which flows through the opening that remains free between the counter-rod and the central port-hole in the piston; it raises the loaded valve and enters the two drums, driving before it the airtight diaphragms above referred to, which act on the compressed air and increase its pressure. This continues as long as the gun has run completely down. An elastic buffer is placed in the rear of the slide to deaden the shock, should the motion of the system exceed in any way the extent calculated for a normal oscillation. When the gun is run down, the loaded valve falls back on its seat and cuts off communication between the recuperator drums and the hydraulic recoil cylinder; the gun then remains run down and can be reloaded and reset. For running it up again, the pointed rod is unscrewed by means of a handwheel; the liquid under pressure can thus flow back to the recoil cylinder; this resumes its former position, drawing with it the arms at the lower part of the beam. The running up of the gun can, therefore, be controlled at will. For rapid firing, the firing device can be arranged to act automatically when the gun has run up its battery, the only stoppage in the action being that for loading and training.

For lateral training, it is sufficient to act direct by traction on the movable slide, with the help of one or more levers placed on the circumference of the platform; a scale enables the position of the gun to be noted and maintained. The required elevation is obtained by working the rods jointed on the gun ring; to this effect the slide shoes, in which is fitted the shaft that joins the two rods at their lower part, extend over the guides in two brackets. A shaft on which two pinions are keyed goes through the two brackets. The pinions gear in circular racks cut in the outside surface of the fixed guides. The system is worked by a handwheel driving the shaft which carries the two pinions. A scale is cut on the outside ledge of the guides. The gun can be set to a given angle of elevation, either when it is run down or when it is in firing position.

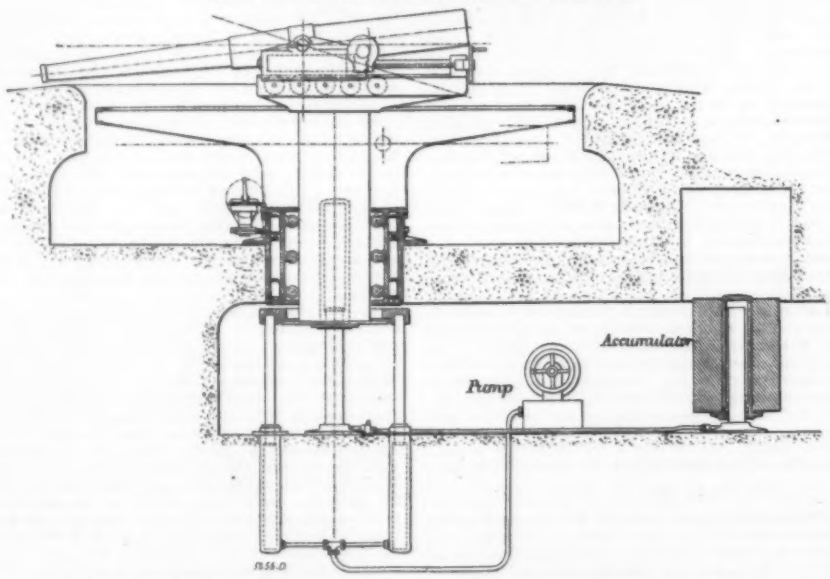
A horizontal shield, carried on columns attached to the slide, protects the various parts of the mounting. It is made with a longitudinal opening to admit the passage of the gun.

24 Centimeter (9·448 inch) Gun on Disappearing Carriage with Counterweight. — This type, though working automatically, can be driven by a steam motor or by electric transmission. It contains only mechanical parts and a counterweight, compressed air not being resorted to.

Weight of gun	22,200 kilos.	(48,942 lb.)
" mounting	124,000 "	(273,370 ")
" projectile	150 "	(331 ")
Muzzle velocity	820 m.	(2,688 ft.)
Elevation	—6° + 15°	
Training, through	360°	



15-Centimeter Gun and Disappearing Carriage.



24-Centimeter Schneider Canet Gun and Disappearing Carriage.

SCHNEIDER-CANET DISAPPEARING CARRIAGES.

The gun is built throughout of steel, and is of a standard Schneider-Canet coast-defense type. The mounting is formed of the following main parts:

(a) The carriage proper, which carries the gun in its movements of recoil and return.

(c) The slide, on which the carriage travels; this slide disappears after each round, and runs the gun up again in a firing position.

(c) The movable platform, which transmits to the system the lateral training displacements. The platform remains fixed during the disappearing motion of the gun.

(d) The bedplate, which carries the whole installation and rests on the foundation.

The carriage proper consists of a cradle; it contains the two lateral recoil cylinders and an intermediate recuperator placed in the center line of the system and at the lower part. It is provided with trunnion-plates, in which the gun rests. The lower surface of each of the cylinders forms a slide-shoe, and is provided with a clamp that holds the edges of the slide guides. The recoil cylinders are on the Schneider-Canet system, with central counter-rods. The recuperator communicates with the cylinders through two branched pipes and a valve-chest; it contains a piston, which, on recoil, is driven by the liquid that flows from the recoil cylinder, and presses down two sets of springs parallel with the center line of the mounting. The slide is formed of two vertical cheeks, the top part of which constitutes horizontal slides, in which are fitted friction rollers of the type previously described to facilitate the travel of the cradle. The slide is continued at its lower part by a cylindrical sleeve made of plates, inside which is the hydraulic cylinder used for raising the mounting and regulating the disappearing action. The vertical motion of the sleeve is guided by a set of horizontal rollers mounted on the vertical pivot of the movable platform. The movable platform carries the horizontal shield and also the lateral training mechanism. It is circular, and its lower face bears on a series of friction balls; it is fitted with a vertical ring to which are attached the centering rollers of the sleeve. The platform is guided in its rotary motion by a second series of rollers the vertical axes of which are fitted to the driving mechanism. The gun can be trained direct from the platform with the help of a crank or through a chain transmission worked by a gunner standing on the shield.

When the gun is in battery, the cast iron counterweight rests on the lower collar. On firing, when the carriage recoils, it travels on the slide rollers, and the recoil cylinder acts in the same way as that for the types described above. When the recoil is spent, the valve that establishes communication between the recoil cylinder and the recuperator, closes and maintains the gun run in. At the same time, the valve which establishes a communication between the main vertical hydraulic cylinder and the accumular, opens automatically, allows the flowing out of the liquid and the gun runs down. It is then reloaded and reset in position. This effected, and the communication with the accumulator remaining cut off, the ring that forms an additional counterweight is raised by means of the forcing pump and the three plunger pistons, to a height that varies according to the angle of elevation under which firing is to be effected. Communication between the hydraulic cylinder and the accumulator is then re-established and the gun runs up in battery under the action of the accumulator alone. The system is then fixed, and, the hydraulic cylinders being turned on the exhaust, the additional counterweight descends, and rests afresh on the caisson collar. A valve placed on the conduit in the thickness of the valve-chest, then re-establishes communication from the recoil cylinders to the recuperator, which, in relaxing, places the gun in a firing position.

A circular track, formed of I-bars, is placed below the shield, and allows the working of tackle, the chain of which carries the box for raising the projectile to the breech.

This type of ordnance is simple in design; it contains safety devices that insure a regular succession in the various maneuvers, and it is most suitable for open coast defense batteries that are so exposed they cannot be protected by artificial means. In the course of firing, a single set of motors is required for maneuvering the additional counterweight, the accumulators being charged before firing commences. The motors

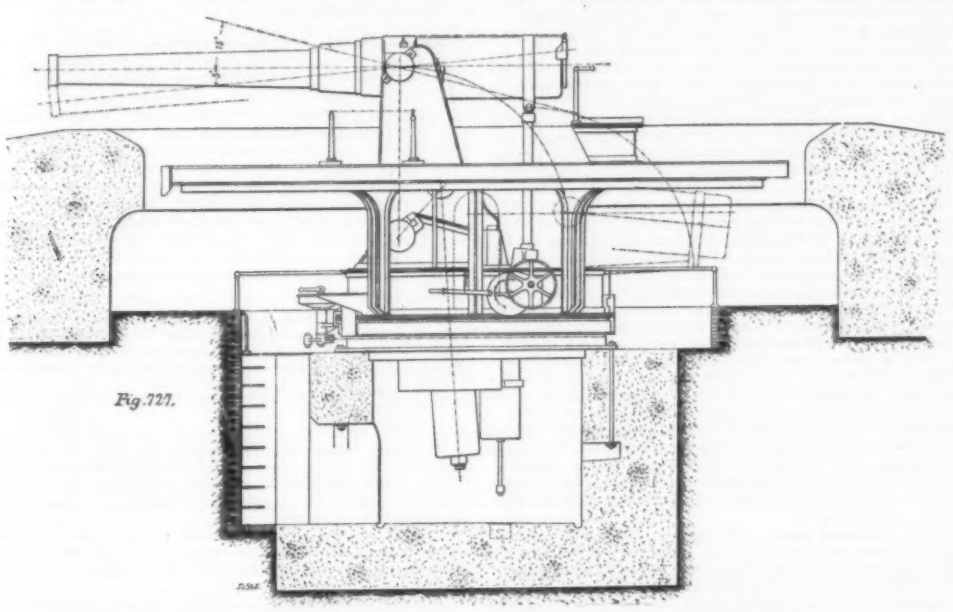


Fig. 727.

27-CENTIMETER SCHNEIDER-CANET GUN AND DISAPPEARING CARRIAGE.

SCHNEIDER-CANET DISAPPEARING CARRIAGES.

the cylinder that forms part of the cast-iron bedplate which carries the whole of the system; this bedplate contains a ring that bears on the foundation, and through which run the foundation bolts. Its top part is made with a groove that forms a path for the friction balls. It is strengthened by a series of radiating ribs. Its lower part ends in a vertical cylinder, which rests direct against the cemented wall of the pit and carries the axles of the guiding rollers of the movable platform. The pit itself communicates with a large-sized room that contains part of the hydraulic mechanism and the counterweight. The room is joined to the battery communications through an underground passage. The fixed plunger piston that works in the hydraulic cylinder is drilled for its whole length and parallel with its center line; the conduit thus established communicates through a tube fitted with regulating valves, with an hydraulic accumulator designed for storing a power slightly above that required for counterbalancing the weight of the movable mounting during running up and down. The cast iron counterweight consists of a large-diameter ring guided in its action by a set of horizontal rollers on vertical guides; at a given moment it can rest completely on a bedplate bolted on the lower part of the movable sleeve and then the weight of the whole arrangement is sufficient to act against the resisting power of the accumulator. The counterweight can be raised independently of the sleeve by three plunger pistons contained in vertical hydraulic cylinders, worked simultaneously by the forcing pump. These hydraulic cylinders are embedded in the foundation.

The required elevation is given the gun by a handwheel placed in the rear of the left-hand cheek of the slide. The transmission contains a set of square toothed-wheels, and endless screw, and differential gearing, working a square pinion that engages the toothed sector fitted on the left side of the gun. Lateral training is obtained with the help of a mechanism similar to that described farther on with the 27-centimeter (10·630 inch) gun mountings. The plate-chain that surrounds part of the circumference of the movable platform is driven by a spurwheel keyed on a vertical shaft, which goes through a chest containing are preferably electric motors, and can be driven by underground cables. This type of mounting can be used in conjunction with the largest caliber guns.

27-CENTIMETER (10·630 INCH) 28-CALIBER GUN AND DISAPPEARING CARRIAGE.—This type of gun and mounting has been supplied to the Japan War Department for defense of Tokio Bay, and to other governments.

Weight of guns	21,720 kilos.	(47,870 lb.)
" mounting	61,300 "	(135,105 ")
" projectile	216 "	(476 ")
Muzzle velocity	580 m.	(1,903 ft.)
Elevation	−5° to + 15°	
Training, through	360°	

The gun is on the Schneider-Canet system, 28 calibers in length, strengthened by a rear jacket and a set of coils. The breech-block seating is cut in the tube itself. The breech-block is the same as that for 27-centimeter coast defense guns; it can be fitted with two metallic cup obturators of different diameter, the second one acting as a spare one for the first in case of need. The mounting consists of the beam, the slide, platform, and the bedplate.

The beam is built up of plates, and consists of two cheeks joined by stay-bars, and one of these is fitted at its top end with a gun-metal butt, to limit the vertical elevation of the gun; the other is provided with a square which, when the gun has run completely down, can connect with the platform and hold the gun down, during the necessary operations for laying and loading it. The beam is fitted:

(a) At its lower part, with an axis formed of two trunnions that are carried direct by the brackets of the slide platform.

(b) At its top part with cast-steel trunnion plates.

(c) With a cross-piece, to which is joined the top of the recoil piston-rod. Both cheeks are, moreover, fitted at their top part with an elastic buffer which can rest, when the gun is completely run down, on buffers on the platform. The slide platform consists mainly of a plate caisson and two vertical brackets fitted with the trunnion-plates for the beam trunnions. It contains all the parts of the mounting, namely: The recoil cylinder, air recuperator, setting mechanism, pump for running down the gun, and it rests on a set of rollers on the bolster. It is fitted also with uprights, on which is held the horizontal shield, circular in shape, and in which is cut a longitudinal opening through which the gun passes in running up and down. The recoil cylinder oscillates round the trunnions carried on the flooring, in two fixed brackets; the flooring is joined to the plate caisson, and is cut out in a suitable way to allow the recoil cylinder free travel in its oscillating movements. The recuperator is in the rear, and is fitted with a collar bolted on the slide platform. Communication between the recoil cylinder and the recuperator is insured through a pipe, which ends on one side at the lower part of the recuperator, and, on the other, on a valve chest. The hydraulic piston-rod is joined to the beam by a cross-piece with trunnions, the central counter-rod is fixed to the bottom of the recoil cylinder. The air recuperator contains an air-tight diaphragm that divides it into two parts—the top division containing compressed air, and the lower one the liquid brought from the recoil cylinder. Through this diaphragm passes a rod provided with a butt to limit its travel. An air-pipe allows the top division to be put in communication with the pressure pump, to run up the gun before firing, should the recuperator have been exhausted.

When the gun is fired it draws back the beam, which turns on its trunnions to the rear, the hydraulic piston descends in the recoil cylinder and drives the liquid into the bottom of the recuperator; the movable diaphragm is displaced and compresses the air of the top compartment. When the beam falls back the air pressure becomes sufficiently high to balance the system, and the valve between the recoil cylinder and the recuperator falls on its seat. During the time the gun runs down, the elevating rod that supports the breech end keeps the gun practically in a horizontal position, and when the motion ceases the gun is placed exactly in the right position for reloading. The breech is then opened, the projectile and charge are introduced, and the fuse made ready; the gun being given afterward the required elevation and lateral training, with the help of the scales and marks provided for this purpose. For running up the gun again, the clamp that holds the beam to the slide is removed and communication is re-established between the recoil cylinder and the recuperator by means of a special lever; the compressed air expands and drives before it the diaphragm which forces the liquid to return in the recoil cylinder, where it acts on the piston. The gun runs up progressively with a speed in relation to the space left free for the flowing of the liquid; it can be lowered when necessary, with the help of a hand-pump, which serves to force the liquid from the recoil cylinder to the lower compartment of the recuperator.

The gun is given the required elevation by working the rod that supports the breech-end of the gun. The rod is jointed at its top part in a ring in the breech-end of the gun and on its lower end, on the elevating sector worked by a pinion keyed on the working shaft, the latter extending outside the shaft in a box fitted with the working mechanism. This mechanism consists of a set of pinions and endless screws driven by the shaft of the elevating handwheel. A pointer that travels along a scale shows the exact angle of the gun to the horizontal. Lateral training is given by a chain which surrounds the circumference of the bolster and passes round the pulley keyed on a vertical shaft; tension blocks serve to guide the chain. The cranked horizontal shaft drives the chain pulley and produces the lateral displacements of the slide by tension on the fixed ends of the chain. A scale on the platform marks the extent of the lateral displacements. In normal service the gun is trained when it is run down and loaded. As it may be necessary, however, to rectify the setting of the gun from time to time, when it is run up in battery, the shield is fitted with a special platform for sighting the gun on the target.

The whole of the mechanism above described rests on rollers on the bedplate, which is bolted on the foundation. When a position has been chosen, the top of the foundation is made with a layer of concrete, on which is placed an iron foundation plate. These arrangements vary according to the nature of the subsoil.

From the number and diversity of types that we have noticed, it will be seen that the Schneider-Canet system contains mountings which can fulfill all the conditions required in service, from those for 75 millimeters (2·952 inch) guns, weighing 100 kilogrammes (2 cwt.) to those for the largest calibers. This section is of special interest, owing to the numerous unsuccessful attempts that have been made in several countries in the adoption of ordnance of this type. The designing of disappearing gun carriages, and their practical working, is a problem difficult to solve, at all events for large caliber guns. The perfection to which the various types of Schneider-Canet ordnance of this nature have been brought means, therefore, a large amount of calculation, trials, and tests of all kinds, carried through a number of years.—Engineering.

ARTIFICIAL FERTILIZATION OF EGGS.

PROF. LOEB, of the University of Chicago, who attracted considerable attention last summer by his experiments in the artificial fertilization of the eggs of sea-urchins and the production of larvæ after an immersion of two hours in a solution of chloride of magnesium and sea water, has conducted a series of additional experiments during the past winter which corroborate the results of the original investigation. In the later experiments the sea water was sterilized, and the most elaborate precautions adopted in cleaning hands, instruments, and specimens before removing the eggs. If a male animal was encountered in dissection, it was removed, and the instruments were not employed again until they had been thoroughly sterilized. The five ovaries of the female were on removal placed in fresh water, and then put into the sea water, one part of the eggs being placed in sterilized sea water as a control experiment, while the remainder were put in the mixture of water and the magnesium chloride solution. The eggs were left in this mixture for an hour, after which they were placed in sterilized sea water, as many as 25 per cent. developing into blastulæ, and swimming about the next day. The other part of the eggs, however, did not even segment, and the most

careful search failed to reveal such a change on the part of any. It was found necessary to use the solution in equal parts and leave the eggs for from one to two hours, in order to secure the segmentation. Prof. Loeb considers that the spermatozoa are entirely eliminated in these experiments, and that his results are accomplished entirely by artificial partheno-genesis.—Medical News.

THE MANUFACTURE OF PUMICE-STONE BRICKS ALONG THE RHINE.

By C. E. Carpenter.

One of the most interesting among the many industries located along the river Rhine, and one which is unique, is the manufacture of brick from pumice stone, which is carried on in what is known as the Neuwied district. This district takes in the country on both sides of the Rhine between Coblenz and Andernach, a distance of between 30 and 40 miles as the crow flies. On the left banks of the historic river, and right in the heart of Neuwied, are the "Eifelberg," a low range of gray, rock-clad mountains, which in former days, many centuries ago, spread their volcanic eruptions periodically over the entire surrounding district.

To these long-silenced volcanoes the people of the so called Bimssand district owe their present unique industry and consequent industrial prosperity. It seems that the huge volumes of sand belched forth by the ancient craters had, with the passage of centuries, gradually disappeared beneath the soil, forming a substrata several feet below the surface. In many places, however, the layer of strata refused to disappear, and yet not until quite recently did the scheme of utilizing the valuable deposits present itself to the inhabitants of Neuwied. Even the practical Romans, whose regime along the left banks of the Rhine dates back scarcely more than four centuries, somehow failed to recognize the value of the stone for building purposes. It is also strange, but true, that Cæsar and his successors, who threw up at this point on the river vast breastworks and other fortifications, did not realize the unlimited quantities of building material at their very doors. In fact, the deposits have remained intact down to the present day.

The formation of the alluvial strata, several feet below the surface, is decidedly curious. Mineralogically it is a foamy porous substance, reaching in many places a depth of 17 feet, while in other localities its thickness is not more than a handbreadth. Equally simple as its formation is the method of removing it adopted by the miners. This consists of nothing more than clearing away the soil, and piling the sand in long hills, from which it is shoveled direct into the mixing bed of water and lime close at hand. The pumice comes out of the earth in pieces, varying in size from mere grains to lumps some four inches across. It occurs in layers, but is frequently interrupted by small cuticular patches of more solid fragments of lava.

Before moulding, the pumice is screened, the larger pieces being broken to pass through a sieve having ¼-inch meshes. These screened pieces are then covered by a thin coating of cement, and the brick is moulded. The cement is not mixed with the pumice so as to form solid cement blocks, but by the fragments being coated first; the brick is then obtained by these coatings adhering to one another.

An idea of the quantity of ingredients necessary in the mixture may be gathered from the fact that for the manufacture of 20,000 brick about 4½ tons of lime are required. After the mixing process the substance is poured into iron molds provided with bottoms of detachable boards, which after the removal of the molds act as driers. When the brick has been exposed to the air for a very short time they are ready for shipment.

As may be seen the process of manufacture is simplicity in itself. No modern machinery whatever is needed, and, therefore, none is used. An industrious workman (i. e., industrious according to German ways of thinking—Americans would call it mis-spent energy) averages from 800 to 1,000 bricks per diem, for which he receives the "magnificent" remuneration of five marks ($1.25), and the working days are confined to the months between April and October.

The total production of Neuwied amounts to about 250,000,000 bricks. It gives employment to a small army of laborers, the most of whom are natives of the small villages of the "Westerwald" and the "Eifel." During the "campaign" these people practically live at their place of employment, in quarters furnished by their employers. The strictest sanitary precautions being required by the authorities, the season's work is in reality one long outing in the open air. In addition thrift is encouraged, prosperity is everywhere noticeable, and, altogether, the natives of the "land of pumice stone," are a happy and contented lot. Many of them—those who travel from a distance to Neuwied for the season—live as gypsies in comfortable wagons hidden away in sheltered bits of forest-land. How long this period of prosperity will last, however, is becoming a serious question; since, as already stated, the strata reaches in its deepest part barely more than seventeen feet in thickness, and must of necessity be exhausted at no distant date. When this state of affairs is reached, it will mean the abandonment of one of the most thriving beehives of industry on the river.

In price, the pumice-stone bricks manufactured in Neuwied fluctuate, of course, with the value of building materials. As a rule, however, an average of eighteen to twenty marks ($4.28 to $4.76) per thousand is obtained, while ordinary bricks sell at 26 and 28 marks ($6.18 to $7.66). In appearance the pumice-stone bricks of the Rhine are white and coarse-grained; in weight they are light, but of extraordinary resistance, and particularly adapted to the building of dwelling-houses, owing to their tendency to keep a house cool in summer and warm in winter. An excellent evidence of their durability is the fact that one of the largest factories along the Rhine has been constructed entirely out of pumice-brick.

The transportation of the brick from Neuwied to the markets is effected by water and by rail. Although the great bulk of the production is consumed in southern and middle Germany, considerable quantities are also shipped to England, Holland and other countries in water communication with the Rhineland.—Brick.

TRADE NOTES AND RECEIPTS.

Mosquitolin a remedy to keep off mosquitos, etc., is composed as follows according to the Pharmaceutische Centralhalle: Cinnamon oil, 1 part; patchouli oil, 1 part; sandal oil, 4 parts; alcohol, 400 parts. As compared with other similar preparations, mosquitolin excels by its pleasant odor.

Enamels.—Following are some recipes for the production of enamels, such as are employed for artistic decorations.

Melt together:

Transparent Red.—Cassius gold-purple, 65 centigrammes; crystal glass, 30 grammes; borax, 4 grammes.

Transparent Blue.—Crystal glass, 34 grammes; borax, 6 grammes; cobaltic oxide, 4 grammes.

Dark Blue.—Crystal glass, 30 grammes; borax, 6 grammes; cobaltic oxide, 4 grammes; bone black, 4 grammes; arsenic acid, 2 grammes.

Violet.—Crystal glass, 30 grammes; borax, 4 grammes; manganese, 4 grammes; cobaltic oxide, 12 decigrammes.

Transparent Green.—Crystal glass, 80 grammes; cupric oxide, 4 grammes; borax, 2 grammes.

Dark Green.—Crystal glass, 30 grammes; borax, 8 grammes; cupric oxide, 4 grammes; bone black, 4 grammes; arsenic acid, 2 grammes.

Black.—Crystal glass, 30 grammes; borax, 8 grammes; cupric oxide, 4 grammes; ferric oxide, 3 grammes; cobaltic oxide, 4 grammes; manganic oxide, 4 grammes.

White.—Crystal glass, 30 grammes; stannic oxide, 6 grammes; borax, 6 grammes; arsenic acid, 2 grammes.

White.—Crystal glass, 30 grammes; sodium antimonate, 10 grammes.

The finely pulverized colored enamel is applied with a brush and lavender-oil on the white enamel already fused in and then only heated until it melts. For certain purposes, the color-compositions may also be fused in without a white ground.

The glass used for white, No. 2, must be free from lead, otherwise the enamel will be unsightly.—Journal de Goldschmiedekunst.

Soap Recipes.—

Eschweg Soap.—Tallow, 197 kilogrammes; palm kernel oil, 167 kilogrammes; Lye 28°, 287 kilogrammes; water glass 18°, 100 kilogrammes; potash solution 20°, 75 kilogrammes; cooking salt solution 20°, 115 kilogrammes; calcined soda, 9 kilogrammes. Blue—Ultramarine blue, 315 grammes. Red—Bole, 250 grammes. Black—Eschweg black, 300 grammes.

Mottled Soap.—Tallow, 30 kilogrammes; palm kernal oil, 270 kilogrammes; lye 20°, 347½ kilogrammes; potassium chloride solution 20°, 37½ kilos. After everything has been boiled into a soap, crutch the following dye solution into it: Water, 5½ kilogrammes; blue, red, or black, 315 grammes; water glass 38°, 10 kilogrammes; and lye, 38°, 1½ kilogrammes.

"Putz" Soap.—Whiting, 1 kilogramme; tartar, ½ kilogramme; white lead, ½ kilogramme; coco soap waste, 7½ kilogrammes; white 1 and water, 4 kilogrammes. Work all together in the milling machine.

Sand Soap.—Coco oil, 24 kilogrammes; soda lye, 38°, 12 kilogrammes; sand, finely sifted, 28 kilogrammes; cassia oil, 100 grammes; sassafras oil, 100 grammes.

Saddle Soap.—Resin curd soap A I, 8 kilogrammes; potash solution 34°, 2 kilogrammes; water, 4 kilogrammes; glycerine, yellow 26°, 2 kilogrammes. Dissolve all in the water bath and fill in tins.

Szegedin Soap.—Tallow, 120 kilogrammes; palm kernel oil, 80 kilogrammes. Saponify well with about 200 kilogrammes of lye of 24° and add with constant stirring, the following fillings in rotation, viz., potash solution 20°, 150 kilogrammes, and cooling salt solution 20°, 380 kilogrammes.

Silver-Polishing Soap.—Work up in the milling machine 10 kilogrammes of planed almond soap A I, with 35 kilogrammes of chemically pure Bologna chalk and a little water into a firm dough. This dough is now shaped by hand into pieces with the die. The pieces are dried until the next day and then pressed. After the pressing the soap is again set aside until dry and hard.—Pharmaceutical Post through Seifensieder Zeitung.

Wholesale Production of Wood Stain.—The so-called walnut stain, a brown, crumbly mass of coffee-like odor and appearance, is produced as follows in practice: 100 kilos. of Cassel brown, of good quality, are ground, until the whole mass is homogeneous, on the edge mill for about 15 minutes, with 17 kilos. of calcined soda and enough water as to form a thick sirup. Same is now taken out from the aperture of the edge mill and spread on iron pans in a height of about 5 cm. which are placed in a strongly-heated drying room, where they remain about 24 hours. By the heat, the humic acid of the Cassel brown separates the carbonic acid from the soda, forming sodium humate and evaporates, carrying the water along at the same time. While the mass was sirupy in the beginning, it now constitutes a brittle, crumbly mass of deep brown-black color, with a strong odor of coffee, and dissolving almost entirely in water upon boiling. The large consumption of this article, which, by the way, formerly, also was used in the chocolate and chicory factories, but was banished therefrom by the food law, is indicated by the fact that in some factories I know two men to be engaged all the year round in making only wood stain by this process. Same is especially popular in America. According to my researches, it can also be produced from peat, especially black peat, by boiling it, same as brown coal, several hours with about 9 kilos. of calcined soda, or, if brown coal is used, with 6 kilos. of calcined soda, boiling down the filtered lye and drying like above; 100 parts of Cassell brown in their percentage of humic acid are equal to 200 parts of black peat or 300 parts of brown coal dust. The above article is usually shipped in large casks or bags, since the humic acid soda is very little dygroscopic. At the same time it also is a very good fertilizer, owing to its soluble humic acid, and furnishes a good writing ink. According to the desired degree of the staining, the percentage of soda can, of course, be increased or lessened. From 100 kilos. of Cassel brown and 17 kilos. of soda about 100 kilos. of walnut stain are obtained, since the carbonic acid does not entirely escape and some water is withheld. The costs are very moderate. From peat or brown coal, they are somewhat higher, owing to the evaporating expenses.—H. Borntraeger, in Farben Zeitung.

SELECTED FORMULÆ.

To Clean Silver.—Rub with a paste made by mixing equal parts of chalk and sodium hyposulphite with enough water. Rinse in water and dry in sawdust.

To Clean Gold.—The Journal für Goldschmiedekunst gives the following formula for a preparation for cleaning and polishing gold ware:

Acetic acid	2 parts.
Sulphuric acid	2 "
Oxalic acid	1 "
Jewelers' rouge	2 "
Distilled water	200 "

Mix the acids and water and stir in the rouge, after first rubbing it up with a portion of the liquid. With a clean cloth, wet with this mixture, go well over the article. Rinse off with hot water and dry.

Perfumes for Hair Oil.—

1. Oil of bergamot	2	ounces.
Oil of lemon	1	"
Oil of lavender flowers	2	drachms.
Oil of cloves	1	"
Oil of cassia	1	"
Benzoin	2	"

Reduce the benzoin to coarse powder and digest in the mixed oils for a week or two, with frequent shaking, and then filter through paper.

2. Oil of bergamot	2	ounces.
Oil of lemon	1	"
Oil of rose geranium	½	"
Benzoin	2	drachms.

Proceed as above.

3 Oil of bergamot	3	ounces.
Oil of lavender flowers	3	drachms.
Oil of neroli	½	"
Benzoin	2	"

Proceed as above.

4 Oil of bergamot	4	ounces.
Oil of sandalwood	5	drachms.
Oil of cloves	2	"
Oil of rose	½	"
Benzoin	2	"

Proceed as above.

Liquid Glue.—Mrs. G. L. D'Ary gives in The Western Druggist the following method of preparing liquid glue which she recommends as cheap and in every way satisfactory:

Brown glue No. 2	2	pounds.
Sodium carbonate	11	ounces.
Water	3½	pints.
Oil of clove	100	mins.

Dissolve the soda in the water, pour the solution over the dry glue, let stand over night, or till thoroughly soaked and swelled, then heat carefully on a water bath until dissolved. When nearly cold stir in the oil of cloves.

By using white glue, a finer article, fit for fancy work, may be made.

Protection of Plants from Insects.—For protection against all non-masticating and many mandibulate insects, kerosene oil is much used. It is exhibited in the form of emulsion, which may be made as follows:

Kerosene	2 gallons.
Common soap	8 ounces.
Water	1 gallon.

Dissolve the soap in the water by the aid of heat, bring to the boiling point and add the kerosene in portions, agitating well after each addition. This is conveniently done by means of the pump to be used for spraying the mixture.

For destroying scale insects dilute this emulsion with 9 times its volume of water; in the case of most others, except lice, dilute with 14 volumes, and for the latter with 20 to 25 volumes.

For the extermination of scale insects, resinous preparations are also employed, which kill by covering with an impervious coating. Such a wash may be made as follows:

Rosin	3½	pounds.
Caustic soda	1	"
Fish oil	8	ounces.
Water	20	gallons.

Boil the rosin, soda and oil with a small portion of the water, adding the remainder as solution is affected.

For the San José scale a stronger preparation is required, the proportion of water being decreased by half, but such a solution is applied only when the tree is dormant.

Renewer for Black Leather.—For black leather articles which have become dull and worn, the following will be found excellent, says the Neueste Erfindungen und Erfahrungen: Dissolve 41 parts of gum arabic in 50 parts of water, and to the solution add 90 parts of black ink, 25 parts of alcohol, and 22 parts of brown sugar. Apply with a sponge.

Colored Glass.—In The Diamond an account is given of R. Zsigmondy's experiments in coloring glass with metallic sulphides, such as molybdenite, and sulphides of antimony, copper, bismuth and nickel. Tests made with batches of 10 to 20 kilograms and with a heat not too great, give good results as follows:

Sand 65, potash 15, soda 5, lime 9, molybdenite 3, sulphide of sodium 2, gave a dark reddish-brown glass. In thinner layers this glass appeared light brownish-yellow. Flashed with opal, it became a smutty black-brown.

Sand 50, potash 15, soda 5, lime 9, molybdenite 1, sulphide of sodium 2, gave a yellow glass.

Sand 10, potash 3·3, soda 0·27, lime 1·64, molybdenite 0·03, gave a reddish-yellow glass with a fine tinge of red.

Sand 100, potash 26, soda 108, lime 12, sulphide of copper 1·7, sulphide of sodium 2·3, gave a dark-brown color, varying from sepia to sienna. In thick layers it was no longer transparent, but still clear and unclouded. When heated, this glass became smutty black-brown and clouded.

A fine copper-red was obtained from sand 10, potash 3, lime 1·2, soda 0·25, sulphide of copper 7·5, sulphide of sodium 10·5, borax 9·5.

Attempts to color with sulphides of antimony and bismuth failed. But the addition of 7 per cent. of sulphide of nickel to an ordinary batch gave a glass of fine amethyst color.—Druggists' Circular.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Poultry Raising in Belgium.—It has been suggested that a report on the methods of raising fowls for the market in this country would be of service, not only to those directly interested in the like business in our country, but a boon to the public at large. The succulence of the "poulet de Bruxelles" has a very widespread reputation, not only among gourmets, but among all who have had the good fortune to travel upon the Continent and meet the same on the table.

The difference in quality between the fowl above mentioned and one of the same age and size of the ordinary variety is shown by the fact that the first is sold in nearly all the markets in this country at double the price. For example, a young poulet de Bruxelles which we should consider about the size sufficient for a meal of two persons is sold to-day for 5 francs (96·5 cents), whereas one of the ordinary variety can be purchased for between 2 and 3 francs (38·6 and 57·9 cents).

The excellence of the fowl seems to depend, as far as can be ascertained, on the careful manner in which the sitting hen is treated, the cleanliness observed about her, as well as the careful feeding of the young chicken until sufficiently developed for eating purposes. Whether or not the methods pursued here differ from those followed by careful breeders in our country, it is impossible for me to say. Travelers almost invariably express their astonishment at its tenderness and juiciness.

The choice of eggs for setting purposes is considered a matter of great importance, and the freshest obtainable are almost invariably used. The best breeders seldom take eggs older than eight days for raising the best quality. Care is taken that the eggs given to one hen should be of the same age. The eggs when collected are kept at a very even and medium temperature until given to the hen, and are turned daily. This measure is taken, I am informed, to prevent the yolk, which is lighter than the white of the egg, from adhering to the top of the shell. The eggs chosen for the purpose above mentioned are also of an average size, those above medium being rejected, as they often contain double yolks. Eggs received from a distance, and consequently exposed to more or less shaking, are allowed to stand a day or two before being put under the hen. Great care is also taken that the eggs should be perfectly clean.

The nest is prepared of straw or cut hay, perfectly clean, dry, and odorless. As a rule, the setting hens are located in corners, where the greatest quiet is obtainable, and are not exposed to great light. When so located, they are not disturbed for any other purpose than the placing before them of their daily supply of food and water. As the hen leaves her nest at least once a day for search of food, to take exercise, etc., care is taken to put her food and water within reach of the nest, in order that the time that she is off the eggs may be materially shortened.

RAISING AND FEEDING.

When the young bird is hatched, it retains in its body part of the yolk of the egg from which it was produced, which suffices to nourish it for the first twenty-four hours, during which period only warmth is required, which is furnished either by the mother hen or must be afforded by a warm cloth in case of the necessity of awaiting the hatching of the rest of the brood.

The food first given can be varied, but must be made up of ingredients containing large quantities of nitrogen, as this is required for the formation of the tissues. It is necessary, in fact, that the food should be composed of matter resembling in character an egg, together with milk. It is customary to mix with the food eggs, milk, and the blood of earth worms, field worms and that of a commoner variety of fish; also to introduce, for the formation of bone, certain quantities of phosphate of lime found in grain and flour. In the early days flour should be given, on account of the facility of its digestion, grain being substituted therefor as the birds begin to gather strength. Wheat flour is generally used. The grain given is wheat, rice, millet, buckwheat, and corn, raw or cooked. Cooked potatoes are also often given, as a change of diet. It is customary to vary the grain diet as much as possible and to frequently administer it mixed. The food ordinarily employed is made up as follows: Hard-boiled eggs and wheat are mixed in milk, a little water being added. To this paste is added a small onion finely cut up, together with lettuce, when green food is scarce. The mixture is ordinarily quite stiff, as too moist food is considered harmful for the young brood.

After the first few days, a small quantity of whole grain is mixed into the paste; but, if rapid development is desired, the simple paste should be continued alone.

Great care is taken to keep the young brood in a dry, warm locality, which precaution, together with the proper food, prevents inflammation of the intestines and like troubles. As a rule, the birds are confined on wet days and allowed to run about as much as possible only in fine, sunny weather. In winter a more generous diet is given to enable them to withstand the cold. The daily ration of grain for the fowls is from 2½ to 3 ounces.—Geo. F. Lincoln, Consul-General, at Antwerp.

American Shoes in Great Britain.—The British Boot and Shoe Trades Journal, in a recent number, said editorially:

"We felt at one time that the importation of a few American-made boots and shoes was a good thing, and calculated to stimulate our manufacturers to greater efforts and cause them to make the pace rather warm for all intending invaders; but the position is now almost analogous to that of the Australian farmer who, thinking that a few rabbits would improve the rural aspect of the farm, imported some. The few soon became many, and the agricultural prosperity of the colonies is now seriously threatened by the thriving rodent. In like manner is the trade threatened by the importation of those few first samples, and mainly because of the indifference with which the importation has been regarded by our own manufacturers."

In another department of the same issue of this publication, the "bagman," as we should say, the "drummer," is credited with this opinion:

"In looking backward, one feels that the spring season has been especially noteworthy in respect to one particular item, viz., every commercial traveler representing a British house has felt American competition to be a real, live fact, and far from being the bogy that it was said to be some time back. Slowly the various American houses have advanced and spread themselves around, adapting themselves to the wants of each particular market with a cleverness which will always make them formidable competitors. They are thousands of miles away, and home manufacturers are on the spot, and yet, in spite of all disadvantages, they have increased their trade and to some extent established themselves."

The sale of American shoes in this country has certainly had a very marked effect on the style of shoe worn, and though they have not gone to quite the extreme, the shoes exhibited in the shoe-shop windows in Great Britain to-day are of the pointed type worn in the United States a few years ago. It is also a singular development of this international dealing that the shoes sold in the United States to-day are broader soled and broader toed than anything worn in England, and this must be due to the creation of a market for the broad shoe in the United States at the time the demand for the same type fell off in Great Britain, owing, no doubt, to the early efforts in Great Britain of the United States manufacturers to sell the kind of shoe then worn in the United States. The splendid finish of the American shoe and its flexible leather won a way for the shoe, carrrying with them the pointed toe under the mistaken impression that it also had a share in the new foot comfort.

The many American shoe salesmen with whom I have acquaintance report very great progress in this market, and find that they are now sought, where formerly they had to plead for an opening chance. One salesman, who was in Birmingham lately, told me that his books for the year recorded the sale of $300,000 worth of shoes in Great Britain alone, and stated that his books would not show all the sales he had made here, because there were so many of his customers who could not be persuaded that they could not buy better by buying from the home house direct.

These figures, it should be noted, represent the sales of one concern, and there are, I understand, at least twenty other shoe houses represented in England.

One New England shoe manufacturer has established a retail store in London, where he sells his goods, has shining parlor, etc., and this establishment has already proved so profitable he is opening another one in a different section of the city, and contemplates an extension throughout the provinces.

Large manufacturers have found it to their advantage in the United States to establish their own retail stores throughout the cities of the country, and this is much more important here, as the average English shopkeeper gives such long credits and has so much of his money represented on his books that he can not keep an extensive stock. The result is that, while in the average shoe store in the United States, one has the chance of selecting from a stock with five widths and half sizes in lengths—seven widths in some establishments—in the average shoe shop here only three widths are kept and no half sizes in lengths; and inability to fit individuals out of a three-width stock assists the shopkeeper in his endeavor to persuade the customer to have shoes "made to order," despite all the chances of misfits which that means. Low price, cash dealings, one price to all, confirmed by plainly marked figures, are features of business just as acceptable to the buyers here as at home. The general public would prefer to be purchasers in competition, instead of patient, longsuffering customers, if they were given the opportunity.—Marshal Halstead, Consul at Birmingham.

The Steel Production of the World.—The steel production of the most important countries is estimated by German authorities for the year 1899 at 26,841,755 tons, against 23,866,308 tons in 1898; an increase of 2,975,447 tons. The cast iron production is estimated at 40,000,000 tons, 4,000,000 tons more than in 1898. Of these 40,000,000 tons, 28,000,000 tons, or 70 per cent., has been used in the production of steel. A comparison of the ten most important countries results as follows:

Country.	1880.	1898.	1899.
	Tons.	Tons.	Tons.
United States	1,287,983	8,970,772	10,702,209
Germany	624,418	5,734,307	6,290,434
Great Britain	1,341,690	4,638,345	4,933,010
France	388,894	1,441,633	1,529,182
Belgium	132,052	653,130	729,920
Austria-Hungary	134,218	860,000	950,000
Russia	295,568	1,153,000	1,250,000
Sweden	28,597	265,121	257,000
Italy		60,000	80,000
Spain		90,000	120,000
Total	4,233,420	23,866,308	26,841,755

—J. F. Monaghan, Vice and Acting Consul, Chemnitz.

New French Spinning Machine.—Although the spinning machines now in use are considered excellent, there is constant effort to bring them to a greater degree of perfection.

The working of the present bobbin frame, one of the preparatory machines, is considered susceptible of improvement. In all preparatory machines, the wool sliver is submitted to twisting and drawing in different directions, to make it regular and sufficiently thin for use in the spinning frame. The sliver in each bobbin machine, after passing through the guide plates into the feed rollers and then into the delivery rollers, should have sufficient resistance to avoid frequent breaking before being wound onto wooden reels.

The problem is to obtain this resistance; in the present bobbin machine, the sliver, in leaving the delivery rollers, passes between condensers corresponding with each head stock of the frame. The condensers are to impart resistance by compression.

These wooden-roller presses are always fitted in pairs, one above the other, and have two movements, one forward movement to make the sliver advance, and a twirling motion which winds the sliver spirally for a certain length on the fluted wooden rollers; besides an alternate twirling motion to wind it spirally in an opposite direction for an equal length, and so on.

Although this double motion seems to have solved the problem of imparting resistance, the condensers wear out rapidly and entail expense disproportionate to the result obtained. The system also requires that each bobbin machine shall be adapted to a special kind of wool, and much annoyance is caused by the sizing employed, as well as by the condensers becoming greasy and discolored.

The invention of Mr. Brule, a Tourcoing spinner, is said to be most practical, although he does not consider it perfect. It operates on natural wool of various kinds and different lengths. The principle of the machine is as follows: The sliver, in leaving the delivery cylinder, instead of passing under the condensers, which are done away with, passes into a special funnel, the center opening of which is in the form of a flattened ellipse, and works by an alternate rotary motion. By this means the sliver receives a twist in one way, is immediately wound on the bobbin, receives a twist in the opposite direction for a certain length, is again wound on the bobbin, and so on.

The bobbin thus obtained is perfectly tight and contains a regular and properly twisted thread, much better than that made on machines fitted with condensers. The machine has a greater yield, and the thread is not tied so often and is more even.

The continuous circular movement of the main shaft on the side of the machine is easily changed into an alternate circular movement, which passes on to an axle under the frame and carries the pulleys corresponding with those of the funnel. The thread thus receives by means of the funnel an alternate twist in one direction and then in the other for an equal length, which is regulated by the speed of the delivery cylinder.

The advantages of this system are an increase of production for each machine—since the speed is quickened without injury to the thread—and a reduction in handwork.

It is said that this machine will be exhibited in working order in the near future at the Technical Institute of Roubaix.—W. P. Atwell, Consul, Roubaix.

Demand for Machinery in Canary Islands.—Consul Berliner writes from Teneriffe, July 11, 1900:

The United States consular agent at La Palma, Mr. Manuel Yanes, has received from the Spanish Government the contract to finish the mole at Santa Cruz de la Palma. This will involve an expenditure of 3,000,000 pesetas (at present exchange about $475,000), and when finished will make one of the safest and best harbors in these islands. His contract is for 400 meters (1,312 feet)—100 meters to be 100 feet and the balance 50 feet broad. He is desirous of getting improved machinery from the United States. He needs, by next January, a crane, and also 1 mile of rails, with an engine and ten cars for loading stone from the quarry.

If circulars and price lists were sent him, no doubt it would lead to an order and an opening for our machinery in this market. All letters should be addressed to Manuel Yanes, Santa Cruz de la Palma, Canary Islands.

Motor Boats on the Dead Sea.—The Dead Sea, which for thousands of years has been a forsaken solitude in the midst of a desert, on whose waves no rudder has been seen for centuries, is to have a line of motor boats in the future. Owing to the continued increase in traffic and the influx of tourists, a shorter route is to be found between Jerusalem and Kerak, the ancient capital of the Land of Moab.

The first little steamer, built at one of the Hamburg docks, is about 100 feet long, and began the voyage to Palestine on June 16. An order has already been given for the building of a second steamer. The one already built and on the way is named "Prodromos" (that is, "forerunner"). It will carry thirty-four persons, together with freight of all kinds. The promoters of this new enterprise are the inmates of a Greek cloister in Jerusalem. The management of the line is entirely in German hands.

The trade of Kerak with the desert is to-day of considerable importance. It is the main town of any commercial standing east of the Jordan and the Dead Sea. Its population consists of about 1,800 Christians and 6,000 Moslems. The merchants of Hebron are among the chief frequenters of the markets of Kerak.—Jno. F. Winter, Consul at Annaberg.

Report of French Steamship Line.—Consul Thackara transmits from Havre, July 6, 1900, a statement of the receipts and expenditures of the Compagnie Générale Transatlantique (French steamship line) for 1899.

It appears that on December 31, 1899, the company's steamers, real estate, personal property at the agencies, material and supplies, amortization deducted, represented a sum of $22,724,585. Three boats were purchased in 1899 and three sold.

The assets were $29,178,287.

Receipts of all kinds, including bounties, were $9,558,542; total expenses, $8,312,765.

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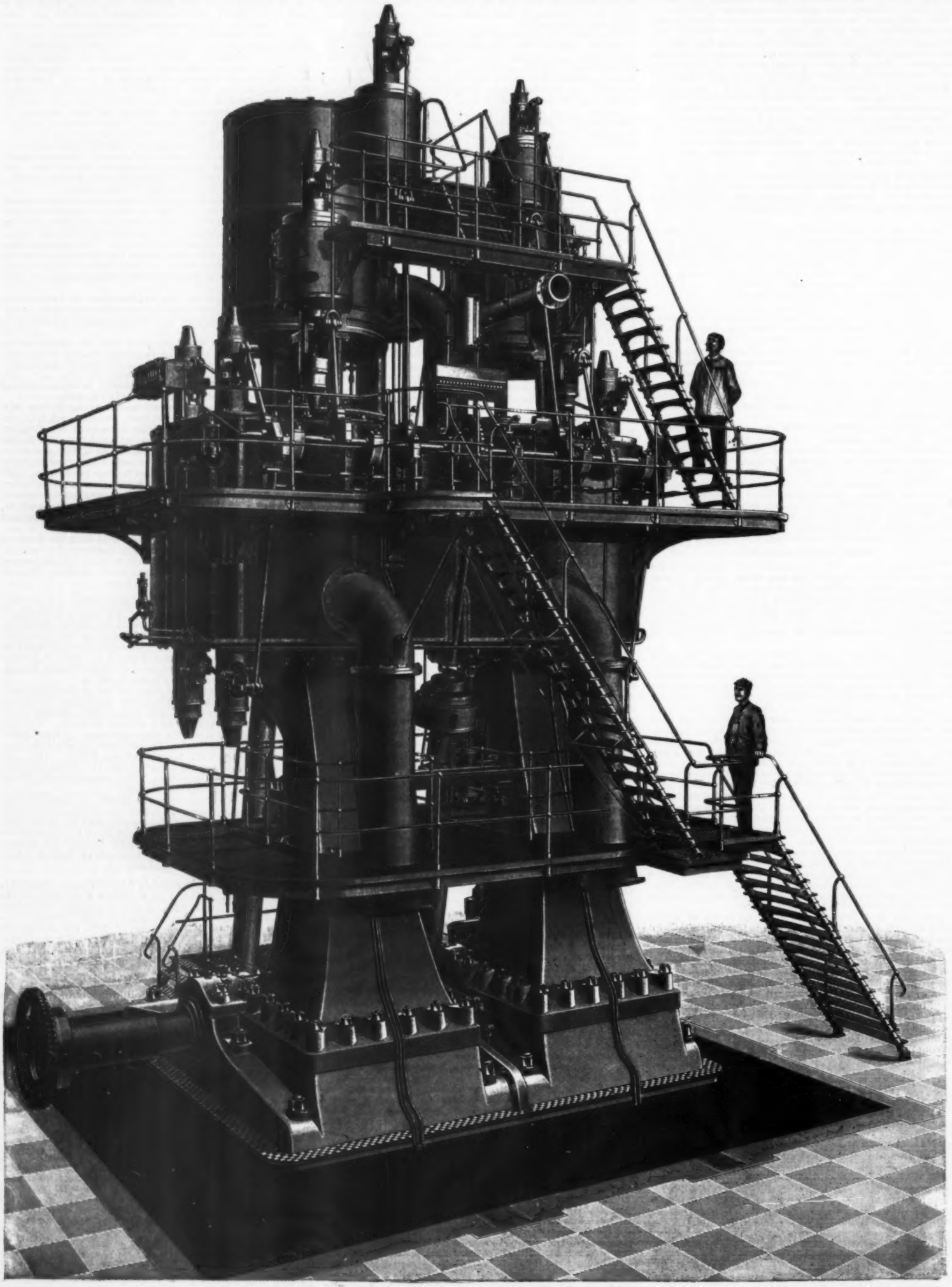
The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

THE BORSIG ENGINE.

IN the Machinery Hall at the Paris Exposition, perhaps the most striking exhibit is the huge Borsig triple-expansion engine which drives a large Siemens-Halske dynamo.

The engine has four cylinders, the high pressure being placed tandem on top of one low pressure and the middle cylinder tandem on top of the other low pressure. The diameters of the cylinders are respectively 30 inches, 46·5 inches, and 53 inches; the stroke is 4 feet. All the cylinders and covers are steam-jacketed. The live steam passes through the first on its way from the main stop valve to the high-pressure admission valves which are located opposite the steam-inlet. The exhaust from the first surrounds the second cylinder; and that from the second surrounds the third. Two single-acting air-pumps are used, one drawing, while the other delivers. The buckets are 43 inches in diameter, and the stroke is 9·8 inches. In each bucket are 19 valves, 4 inches in diameter; and in each pump are 24 delivery-valves. No suction valves are used. The pumps are driven from opposite ends of an equal-armed lever on a rocking shaft oscillated by a connecting-rod from the pin on an overhung crank disk on the free end of the main shaft. The condenser is of the injection type.

The main frame consists of massive iron box columns on one side, carrying the one-sided guide-bar slides, and on the other of forged steel solid rods 14 inches in



THE BORSIG VERTICAL TRIPLE-EXPANSION ENGINE.

diameter. The crank-pins are 15·75 inches in diameter by 17 inches long. The main bearings have the same diameter, 15·75 inches, and the four bearings in the main bed-plate have a total length of 8 feet 9 inches. Beyond these comes a4 1-ton flywheel, between which and the dynamo is a fifth bearing, 19·7 inches in diameter by 48 inches long. The engine and dynamo shafts are coupled between this last bearing and the fly-wheel by flanges and bolts. A sixth smaller bearing is located between dynamo and exciter, which last is mounted directly on the overhung end of the shaft.

Between the two bearings on the inner sides of the cranks, the shaft drives at twice its own speed by bevel-gearing a long shaft, slightly inclined to the vertical, and carrying a ball-governor.

The valve-gear shaft carries eight eccentrics which drive the sixteen valves for the four cylinders in pairs, each eccentric actuating an admission and an exhaust valve for the high pressure and second cylinders. For the two low-pressure cylinders, each eccentric drives either a pair of admissson valves or else a pair of exhaust valves. The sixteen valves are all tripped by the same pattern of gear.

The engine is intended for a steam pressure of 14 atmospheres and a speed of 90 revolutions per minute. With a normal cut-off in the high-pressure cylinders of one-quarter the piston-stroke, it should develop 2,500 horse power, with a condenser-vacuum of 690 mm. mercury. The latest cut-off is $\frac{1}{7}$; and with this the horse power would be nearly 3,000. Only 9-atmosphere steam is available at the Exposition, for which reason the horse power is very much lower.

Influence of Fixing Agents upon Structure.—It has been stated by Gulland that when salmon enter our estuaries there has begun an extensive desquamative catarrh of the mucous lining of the intestines, which spreads upward to the stomach. The specimens on which this statement was based were fixed in perchloride of mercury. Barton now shows that if the stomach and intestine of the salmon be placed at once in a mixture of equal parts of spirit and ½ per cent. chromic acid, so far from their being any desquamative catarrh, the mucous membrane reveals the most perfectly natural epithelium. It is most important, in order to obtain the normal appearances, to avoid post-mortem change, and not to fix in perchloride or formalin.—Journ. of Anat. and Physiol., April, 1900.

THE PAVILION OF BELGIUM AT THE PARIS EXPOSITION.

THE Pavilion of Belgium on the "Street of Nations," on the bank of the Seine, is located between the British and Norwegian sections. It is a splendid example of Flemish architecture and reproduces the best portions of some of the more celebrated town halls and municipal buildings in Belgium. The central tower is an exact reproduction of the Hôtel de Ville at Audevarde, whose architect, Van Pede, has been called the Benvenuto Cellini of stone; by hardly any other artist has stone been rendered so delicate and lace-like in a building. The ground floor is devoted to a press exhibit and here will be found all the newspapers, periodicals, etc., published in Belgium. In the next department are arranged views and models of the principal buildings of Flanders. In the basement is a beer vault. The first floor contains an exact reproduction of the great chimney piece at the Hôtel de Ville at Audevarde. The walls are adorned with frescoes and tapestries and there is a splendid exhibit of ancient Flemish tapestries. There is also a reception room richly hung with tapestries.

THE PAVILION OF BELGIUM AT THE PARIS EXPOSITION.

THE TELEGRAPHONE.

THE telegraphone, exhibited in the Danish section, is considered by all specialists as one of the "hits" of the Paris Exposition of 1900.

Let us, in a few words, recall the principle and method of operation of this apparatus, which is due to M. Poulsen, engineer of telegraphs, at Copenhagen.

In this circuit of a dry battery of two or three elements is placed a microphone and a very small electro-magnet. In the microphone, as well known, the vibrations of the voice cause an increase and diminution of the electric resistance. To such increase and diminution correspond modifications in the same direction of the current of the battery, and, consequently, corresponding variations in the current of the small electro-magnet.

A piece of soft iron placed in the vicinity would be magnetized and demagnetized by turns, although such magnetic variations would be as fugitive as the sonorous vibrations that give rise thereto. This is what occurs especially in many telegraphic apparatus. If the soft iron be replaced by steel, this metal will become magnetized with more difficulty under the influence of the variations in the current; but, as an offset, the magnetism obtained will persist much longer through the effect of a sort of viscosity that bears the name of "coercitive force."

Up to the present this property of steel has been an annoyance in practical applications. Soft iron has been employed almost exclusively in apparatus, and no practical and precise idea has, therefore, been obtained as to how much magnetism steel can take under the influence of a variable current, nor as to the exact duration of such remanent magnetism.

M. Poulsen has conceived the happy idea of utilizing for phonography what has everywhere been considered as a drawback in steel. He causes the small electro-magnet to travel along a cylinder upon which a steel wire is spirally wound at a very short distance. The variations caused in the current by the sonorous vibrations are magnetically inscribed upon the wire, and (what was not anticipated) become localized in the very circumscribed region situated immediately in the vicinity of the electro-magnet. Such magnetic inscription persists and is maintained almost integrally upon the wire for a very long time—say, for several months or a year.

Therefore, if we combine the electro-magnet with a Bell telephone and cause it again to traverse the route that it has already traveled, it will meet thereon the unequal quantities of magnetism that it has itself disseminated. The intensity of the current will be modified at each meeting, and such electric variations will be shown in the telephone by sonorous vibrations. In a word, the magnetism inscribed in the first place upon the cylinder and afterward the magnetized cylinder acts upon the electro-magnet, and, consequently, upon the telephone, and there is a reproduction of the voice. But it is necessary also to be able to efface the inscription first made upon the wire, in order to write another one. M. Poulsen reaches this result by passing through the electro-magnet a constant current of contrary direction that, so to speak, planes off the inequalities of the remanent magnetism.

Let us now give a brief description of the apparatus. Fig. 1 represents the small electro-magnet of actual size. The axes of the two coils form an acute angle so as to embrace the wire, *f*, at right angles with its length. Fig. 2 shows the cylinder, *C*, covered with its wire. This cylinder is 15 inches in length by 5 inches in diameter. The wire is $\frac{1}{10}$ inch in diameter and is wound in 380 spirals.

The electro-magnet, *E*, is supported by a small carriage, *c*, which, arrested at the end of its normal travel by a stop, *T*, engages at this moment with a screw, *w*, which brings it back to its starting point. The electro-magnet and cylinder are set in motion by an electric motor of ½ horse power. The normal duration of the carriage's travel is 50 seconds.

Despite the very disadvantageous conditions under which the apparatus is placed at the Exposition (in the Gallery of Machines, in the midst of noises of every nature), the telegraphone operates very well as a phonograph when the electric motor runs regularly. We advise visitors who desire to assure themselves of this to pronounce in a loud voice, and in their own language, the phrases that they wish to make the instrument repeat. Such a precaution is very necessary, since a German phrase, for example, repeated by the most improved phonograph in the presence of a Frenchman who has but an imperfect knowledge of German, will necessarily appear confused, through no fault of the apparatus itself. With an air whistled or sung the case will be different.

It will be found, even, that in the telegraphone, phrases and airs do not exhibit the nasal and disagreeable character of the sounds emitted by the ordinary phonograph. This is explainable by the fact that the accessory vibrations corresponding to the friction upon the wax and to the sound of the stylus are suppressed.

Of the apparatus under consideration some very interesting applications may also be made as a telephonograph. For example, for inscribing and transmitting to any distance a speech lasting from half an hour to an hour or more, it has occurred to M. Poulsen to replace the cylinder and wire of the telegraphone by a spirally wound steel ribbon, which, unwinding automatically under the inscribing electro-magnet, receives the magnetic inscription which it is capable of afterward transmitting to the electro-magnet of a Bell telephone. When the speech is finished, if it is not desired to preserve it, the ribbon is made to pass in front of the effacing electro-magnet.

A point to be noted is that upon the ribbon, as upon the wire, the magnetization produced is localized upon a very small surface.

As for the duration of the remanent magnetism, that may reach a year, after from 500 to 1,200 repetitions. Quite a curious demonstration of this has presented itself. M. Schmidt, the engineer in charge of the mounting of the telegraphone, in experimenting at the Exposition with the apparatus sent from Denmark, found upon one of them a phrase that he had heard at Copenhagen, and which had withstood the packing, the voyage, and the unpacking of the instrument.

Another application is the simultaneous transmission, to any number of subscribers (as many as a thousand, it is said) to the telephone, of a speech, lecture, music, the news of the day, etc. The arrangement for this purpose is shown in Fig. 2, where *A* and *B* are two parallel and horizontal pulleys over which runs an endless steel ribbon, *R*, and where *Ei* and *Ee* are two electro-magnets placed symmetrically. The first of these latter inscribes and the second effaces. Between the two are interposed any number of electro-magnets, *El*, for listening or reading. Finally, M. Pederson, one of M. Poulsen's collaborators, has devised a system which, through the application of a differential winding, analogous to that of the duplex telegraph, permits of inscribing two phrases at once.

It is much to be desired that experiments on these various applications shall be made at Paris during the course of the Exposition. At all events, the principle established by M. Poulsen and its application to telephonography seem to us to be of the highest interest. For the above particulars and the illustrations, we are indebted to La Nature.

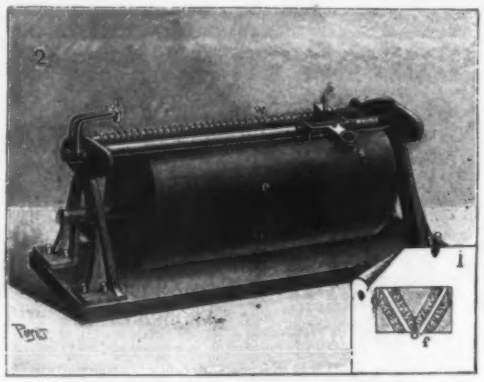


FIG. 1.—THE TELEGRAPHONE.

1. Section of the electro-magnet; *f*, steel wire. 2. *C*, cylinder covered with steel wire; *E*, electro-magnet; *c*, carriage; *W*, screw; *T*, stop.

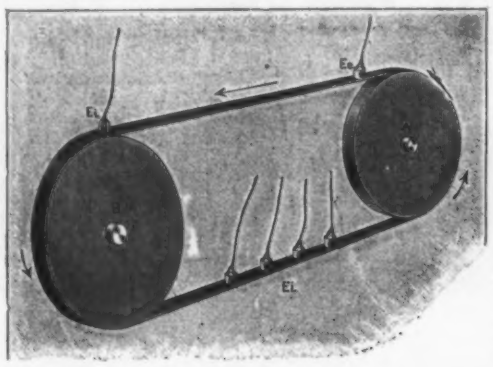


FIG. 2.

A and *B*, pulleys over which runs the endless steel ribbon. *Ei*, inscribing electro-magnet; *Ee*, effacing electro-magnet; *El*, reading electro-magnet.

CONTEMPORARY ELECTRICAL SCIENCE.*

PERMANENT MAGNETS. — An exhaustive investigation of the various conditions affecting the permanency and the moment of a steel magnet has been carried out by H. Frank. A number of magnets were prepared of the same piece of English silver steel. They were chilled from several high temperatures ranging from a dull red to a white heat, and then magnetised by the same current and coil. The highest magnetic moments were shown by those magnets which had been chilled from a normal red heat, midway between the dull red and the white. The influence of the temperature is very considerable. Thus the moment obtained after heating to normal red is double that obtained after heating to dull red, and 30 per cent. higher than that obtained after heating to a white heat. The duration of the heating, however, seems to have no influence whatever. The temperature at which the magnetisation itself is carried out is also of importance. If carried out at a low temperature, the moment obtained is higher than if the magnetisation takes place at, say, 100°. But the difference is very slight when the steel has been chilled from a bright red or a white heat. The "loose magnetism" is more easily got rid of when the chilling took place from a low heat than from a high one, and Barus and Strouhal's methods of ageing magnets either by boiling or by cycles of temperature appear to be the best all around.—H. Frank, Ann. der Physik, No. 6, 1900.

ELECTRICAL TRANSPARENCY OF LIQUIDS. — With very simple apparatus, A. de Heen has demonstrated some great inequalities in the transparency of liquids for electric waves. He produced electric waves by attaching a piece of wire gauze to one terminal of an induction coil driven by a Wehnelt interrupter, and let them traverse a set of two concentric test-tubes, the outer one being filled with the liquid to be examined, while the inner one contained a sensitive vacuum tube serving as a wave indicator. It was found that all the liquids examined could be divided pretty sharply into two classes, the transparent ones and the opaque ones respectively. The former include ether, petroleum, benzine, xylene, and butyric and valerianic acids. On the other hand, water, alcohol, aldehyde, carbon bisulphide, and ethyle bromide are opaque to electric waves. This classification shows no connection with other physical properties; for all the liquids are transparent to light, and electrostatic conductivity seems also to be without any determining influence, for water and ether are both conductors, and yet one of them is opaque and the other transparent. A good deal of interest attached to mixtures of an opaque and a transparent liquid. The transparency of ether was reduced from 1,232 (in arbitrary units) to 73 by adding 30 per cent. of its volume of alcohol, and to zero by adding 43 per cent.—A. de Heen, Competes Rendus, May 28, 1900.

NEW SPARKING PHENOMENON.—W. J. Humphreys has noticed that the discharging distance between the poles of an ordinary Toepler machine could be very greatly increased by the aid of small sparks, taken by the hand or otherwise from the negative pole, or from any part of the machine in metallic contact with it; and also that this property is peculiar to the negative side, no such effect being produced by sparks taken from any of the positive parts. The same phenomenon occurs in the case of other types of influence machines, the increase in the sparking distance being often as much as 75 per cent. The poles should be well polished, and condensers should be added to produce the best results. The outside coatings of the jars should be connected with a metallic rod. The phenomenon ceases when the outer coatings of the jars are so insulated that there can be no oscillations or "surges" between them. That the breakdown takes place only when the auxiliary spark is taken from the negative side is explained by the author by supposing that the dielectric is far more sensitive to shocks next the anode than it is next the cathode. For "a spark from either pole will cause an impulsive rush of the opposite charge to the other pole and a consequent rise of its potential." The author does not seem to take into account the ultra-violet light of the auxiliary spark.—W. J. Humphreys, Phys. Review, May—June, 1900.

LOW-TEMPERATURE PHOTOMETRY.—To determine the manner in which the brightness of a luminous body increases with the temperature, O. Lummer and F. Kurlbaum compared the radiation of a "black" hollow space at various temperatures with that of a piece of platinum foil kept at a constant temperature, and reduced the radiations to apparent equality by means of Abney's revolving sector. The relation between brightness and temperature may be expressed

$$\frac{H_1}{H_2}=\left(\frac{T_1}{T_2}\right)^x,$$

by the relation where H is the brightness, T the absolute temperature, and x a coefficient which varies with the temperature. This coefficient has at low temperatures an extraordinary high value, being 30 at 900, abs., 25 at 1,000°., and 15 at 1,600°. This circumstance is greatly in favor of photometric measurements of temperature. Differences of color are fortunately not so fatal as might be expected, owing to the fact that when two adjacent patches of different tints are equal in brightness, the dividing lines lose their sharpness. The measurements were made with the help of a Lummer-Brodhum prism. The authors promise to determine x for all available temperatures.—Lummer and Kurlbaum, Verhandl. Deutsch. Phys. Ges. II., No. 8.

DISCONTINUITY OF CATHODE RADIATION. — The nearest approach yet made to a continuous cathode ray discharge is probably the high-voltage continuous-current discharge described by Trowbridge. He, however, beyond mentioning that he employed several million ohms to eliminate the oscillations, does not bring any direct proof, by the telephone or any other method, to show that the discharge was really continuous. Some experiments recently made by P. Villard go to show that cathode rays have a strong tendency to discharge themselves intermittently, and that they do it, so to speak, on the slightest provocation. He makes a cathode beam rotate about its axis by means of a revolving magnetic field. A continuous beam would then describe a circle on a fluorescent screen. But a cathode beam only produces a series of patches arranged on the circumference of a circle. When the tube is worked by an alternating current, each active semi-period is thus broken up into a series of equidistant discharges. The discharge of an influence machine is similarly broken up, and Birkeland has shown that the same rule applies to the discharge of an induction coil.—P. Villard, Comptes Rendus, June 25, 1900.

INFLUENCE OF GRAVITATION UPON RESISTANCE. —A somewhat recondite but none the less interesting research has been carried out by G. Gore. He had already shown that the presence of a mass of a heavy substance near one of the electrodes of a voltaic cell alters its E.M.F. Why it should do so could not be determined except by a lengthy series of experiments upon solids and electrolytes. The most obvious explanation was some change in the constitution of the electrode. If there were any such change, it might also show itself in a change of resistance consequent upon embedding a coil in a block of lead. A somewhat tedious series of experiments has been carried out by the author, and it says a good deal for his care and accuracy that he should have obtained a negative result; for positive results, due to secondary causes, are very much more easy to obtain. It appears, therefore, that the gravitational action observed in the case of electrolytic cells probably does not act through the metal. A full explanation of this interesting effect will probably demand more than the patience of a single worker.—G. Gore, Phil. Magazine, June, 1900.

PHOTOGRAPHIC EFFECTS FROM RADIATING WIRES. —The mast wire used in "wireless" telegraphy is known to give out a slight rustling noise when in action. T. Tommasina has followed up this observation by inserting a short length of thin wire enclosed in a light-tight box in the mast wire, and has observed luminous brushes, which he has also photographed. The brushes vibrate in unison, not with the oscillator, but with the interrupter of the induction coil. When both are in unison the brushes are distributed at regular intervals along the wire. They can be photographed by placing the sensitive plate in immediate contact with the wire. It then appears that the brushes form straight lines normal to the wire. When the sensitive plate is laid face downward, and held down by wooden block, there is a minimum of brushes under the middle of the block and two maxima at the

*Compiled for The Electrician by E. E. Fournier d'Albe.

ends. Under an iron block the minimum is not so pronounced, but there is a distinct convergence of the brushes toward the middle, as there is in the magnetic lines of force of a bar magnet. The finer the wire the smaller are the brushes and the closer together they are. The author concludes from these observations that the electric energy radiated by the wire, and partly converted into these brushes, is propagated from the individual molecules in planes at right angles to the wire.—T. Tommasina, ComptesRendus.

THE FUTURE OF THE AUTOMOBILE—SUGGESTED IMPROVEMENTS.*

AUTOMOBILISM has been racing with the strides of a giant. But a giant's stride should not be for velocity alone. Has not the absorption of attention on improvements for speed relegated to the second place the consideration of defects in our vehicles which should be met with the profoundest study? I do not wish to criticize an evolution easily comprehensible and perhaps necessary. I will not give retrospective counsel. Leaving the past, let us glance at the future, and determine in a general way the kind of progress which ought to be kept in view as an important end to be realized. We now see vehicles for speeding or for pleasure-riding supplied with motors of 24 to 30 horse power. Are these excessive powers to be continued? Are they really useful in the development of this noble industry? I do not hesitate to answer, No. So long as the motors are not more subject to control, this force is excessive, except for heavy weights, which do not make for speed. The kings of the road are to be admired for coolness and nerve. That does not affect my opinion that racing ought not to be the engrossing purpose of automobilism. Instead of resting content with the construction of motors more and more powerful, we ought to study thoroughly what is imperfect in the mechanism and seek for the means of improving it.

To have a motor, comparatively light, capable of climbing a steep hill at breakneck speed, is not the finality; it is needful to follow horse-driven vehicles without being pitilessly shaken up. How do these fine machines act? The driver has to be constantly on the qui vive; the motor works spasmodically; the jarring is intolerable.

But perhaps you will say: "That comes from the explosive motor not being elastic. We must let it have its own way."

I answer: "You speak the truth. But we have some means of rendering it more 'elastic,' and others will be discovered by close and persevering study."

Another inconvenience of very powerful motors—the result, too, of the lack of mobility—is the difficulty in slowing up, without constantly putting the brakes in action, ungearing the mechanism, and interrupting the circuits, if there are any. You have only four speeds; there should be six or eight, and that would complicate the whole machine.

Look at the bicycle. Why did it jump to comparative perfection so quickly? Simply because the average force of the human motor could not be augmented. So the genius of inventors was directed to that series of improvements, which, reducing the passive resistance, made the bicycle what it is now, a popular instrument of locomotion adopted almost universally. The automobile machine owes many of its organs to the bicycle, of which it is the natural outcome, substituting inanimate power for the living motor. Freed from the trammels imposed by the limit of muscular effort, we would do better to pursue the path traced by our predecessors, and seek to overcome the passive resistance and aim at general perfection, instead of launching into an orgy of kilogrammeters.

Let us consider some of the weak points and the possibility of improvement.

I will commence with the motor, the principal organ, the soul of the automobile. I will speak of the explosive motor, of the quadruplex cycle, because it has perhaps the greatest need of improvement, and because it is in general use—a preference accorded to numerous good qualities, notwithstanding its imperfections.

The greatest defect is the one referred to before, the lack of adequate mobility. It does not work with sufficient variations of force; the regulation is defective; the ignition is a delicate operation and often troublesome; the refrigeration of the parts requires to be simplified and studied with reference to increasing the yield. This is only, say, 15 to 20 per cent. of the calories furnished to the motor. The effective yield scarcely ever exceeds 12 per cent., and should be desidedly increased.

What can we do to ameliorate the elasticity of the motor? The pressure in the cylinder should be varied as much as possible. For motors with incandescent ignition this is not convenient, because the lowest limit of pressure is soon reached, and its increase is attended with difficulty. The inactive gases confined in the platinum tubes after a first explosion require considerable pressure to be driven back and allow the fresh mixture to reach a sufficiently heated part.

Operators who wish to utilize the advantage of a weak pressure, which they obtain by contracting the admission a little, increase by a few pump strokes the pressure of air on the tube feeding the burners. This accomplishes something, but is not sufficient. As to the forced compression, it has been obtained by different methods, of which the principal defect is to complicate the mechanism by the addition of new pieces liable to get out of order, and especially to render the cooling still more difficult. These systems all tend to change the relative positions of the bottom of the boiler and the foundation of the cylinder. Let us, therefore, abandon ignition by incandescence and require electric ignition to aid us in obtaining what the other will not give. Let us take as a point of departure the valuable information afforded in this respect by the Dion motor.

Electric ignition does not require compression. A mixture well prepared is inflamed by spark sufficiently hot or voluminous, at a little below atmospheric pressure.

We can, therefore, diminish the pressure by acting on the admission, while increasing slightly the richness of the mixture. We have, also, the lever for advancing or retarding the ignition.

The source of electricity and its power, and the position of the point of deflagration are also of importance and deserve to be studied closely. To augment the force of the motor we admit a mixture sufficiently rich, and we give the advance to the ignition, in proportion to the speed of the motor. Let us not forget that the flame is not propagated instantaneously, and that a mixture rich in hydrocarbons burns more slowly than a mixture of more common proportions.

So much admitted, let us inquire what effect we can derive from two points of ignition more or less separated. Here is a material progress to be realized. Poor mixture—one candle in action, or two at best. Rich mixture—always two.

"How two?" you may ask.

Simple enough. I propose to go a little beyond those who use burners and electric ignition combined. I propose the employment of two electric ignitions for each cylinder, with parts entirely separated. The two ought to be able to act with perfect synchronism; each ought also to be able to act alone. It is for the makers to find the solution of this problem. With two ignitions irregularities in the explosions will become more and more rare, especially if we employ magneto-electric machines, which, according to M. Knap, have the advantage of giving us the hottest spark.*

The skillful driver, understanding his motor thoroughly, can, by utilizing all the advantages which the best ignitions afford, realize great variations of force; but even the most skillful would be willing, in ordinary circumstances, that a good regulator should facilitate his task and leave him a little more time for enjoying the landscape. The regulation ought, therefore, at least in part, to be automatic.

Let us abandon old time ideas applicable only to shop gas motors, and cease applying to our speeding motors the old coarse and barbarous maxim, everything or nothing. A plan of regulation, well conceived and executed, ought to utilize whatever may contribute to enlarge the control of the motor, moderating or augmenting the force within certain limits, without the necessity of interfering with it every minute. The Mors motor does not seem far from the true path in this respect. The practice of applying the brakes, while keeping the escape valve closed, then letting it free, while the motor sets off anew under the influence of the full admission, is not in keeping with the march of true improvement. The principle of everything or nothing, is an opposite and radical extreme. Allow an intermediate phase. For my part, I would like to see the regulator act on the admission of the mixture up to the point when proper ignition ceases; then the electric current should be cut off. The escape valve might remain open. This is useful for cooling, while in the Mors motor it prevents the entrance valve from working. For machines with several cylinders, the regulator, after reducing the admission, might act successively on the escape of each cylinder, rendering the movement more gentle and uniform. The movement of the mass of the regulator might cause the motor to pass through an inverse phase, which would be much more simple than if the mechanism were to bring us back suddenly to a complete admission. Finally, our regulator might well be charged with increasing the richness of the mixture, while the motor relaxed under the effect. If, then, we have two simultaneous ignitions, the mixture, though slower to explode, will yet reach the deflagrating point soon enough to considerably augment the force of the motor.

The question of automatic regulation, it will be seen, is intimately connected with the carburization. The other day an article appeared in an English journal headed "New French Carbureters." There were at least five of them, and at the end of the article the writer promised a continuation. What enterprise! It's the cry of the huckster: "Ladies and gentlemen, here are carbureters to suit everybody."

Instead of varying at random these alimentary and respiratory organs of our machines, without making them better, often making them worse, would it not be preferable to seek for a really new idea, a radical improvement?

Let us create a type of carbureter uniting all the essential conditions of homogeneous carburization and less subject to the influences of the outside temperature and of the quality of the hydrocarbons employed. In order to realize the result, it is necessary to abandon the empiricism which retards progress all along the line. If we investigate the scientific side of the problem, if we follow the comparative and experimental method of studying, one after another, the parts now defective, we shall arrive at a sure result. To realize mechanically, a satisfactory arrangement and construction will then be easy. The carbureter is certainly a part not to be neglected; the production of a good mixture is an essential requisite for obtaining a satisfactory yield. With the ever-ongoing of the popularization of the automobile, the question of the yield grows constantly in importance. It is not for the carriage of luxury and pleasure to scatter calories in all directions; the vehicle of public service, the industrial automobile, ought to have an abundant yield, and economize the hydrocarbons as much as possible. The higher the utilization, the more perfect the carburization, the more we shall succeed in suppressing the disagreeable odor which excites hostility.

But suppose that our carburization, and with it the combustion, is as perfect as possible, shall we thus secure a greatly superior yield? I fear not. The amelioration, though perhaps considerable, will not be phenomenal. This results first from the inherent imperfections of the quadruplex cycle, which we cannot now consider. It proceeds, also, in large part, from the loss of heat which we are forced to undergo from the necessity of cooling the cylinder and the valves. The refrigerating water is alone capable of taking from us at times as much as 80 per cent. of our calories. Isn't this rather too much? If we aspire to have a motor as obedient to control as possible, we must not forget that the variations of velocity will logically permit corresponding deviations of temperature to assure the refrigeration. This ought to be regulated according to the temperature of the surrounding air. The motor should be furnished with a refrigerating system, regulated automatically at will, according to the velocity of rotation.

With the present water circulating plan it is impossible. This has, too, the defect of complicating the mechanism by the addition of tanks, radiators and pumps, causing multiplied trouble. The air and sprayed water are better for the purpose, though the question is beset with difficulty, especially for powerful motors. The winglets alone cannot be relied on for efficient cooling, particularly those cast with the cylinder or valves. The walls of the cylinder should be as thin as possible, made of steel, nickel or other metal of sufficient strength. The selection of a metal for the winglets requires research; its coefficient of dilatation should approximate that of the cylinder. The method of attachment is also important. The parts most subjected to the heat require the most aid in cooling, and should be made of metals slightly liable to oxidation, and strongly resistant to the action of elevated temperatures.

The construction of motors without circulation of water should be secured. It will be necessary to generate currents of air, mixed, so far as needed, with sprayed water or steam. Such currents could be economically produced by utilizing the energy now thrown out through the escape pipes. When we reflect that the gases issuing from the cylinders are still under a pressure of 3 or 4 kilogrammes, it is evident that this force ought logically to be utilized, if it can possibly be done without complicating the mechanism of our machines beyond measure. It is for the constructors to devise simple and practical methods. Among the motors adopting refrigeration by propulsion of air and winglets, the Minerva appears to me worthy of attention. The piston, hollow and prolonged by a pipe surrounded by several elastic segments, draws in at each stroke a quantity of fresh air, which circulates through the center,* and goes out again, heated, by the entrance orifice. This interior cooling, occasioned by the movement of the piston, is, therefore, proportioned to the speed of the motor.

I believe that by adapting the Minerva system, and applying what can be done in the way of exterior cooling, we may be able to secure powerful machines without water circulation. If the chemist succeeded in providing us with lubricators, supporting without decomposition higher degrees of heat than the oleonaphthas now in use, oils which disaggregate at 350° to 400° C., we can use this gain of temperature for increasing the yield of the motor. But the more capable we may become of regulating the refrigeration at will, the more, also we ought to seek not to draw from the motor more than is necessary. We shall enter a new path requiring much scientific study and practical research.

As proposed at the outset, I have considered the progress which I deem practicable for the quadruplex motor, familiar to us from constant use. Throwing a look forward, we can see in a future not remote the realization of many improvements now in an embryonic state. But the more we advance toward the horizon, the farther it recedes from us. By the time we reach the line which to-day limits our visual field, we shall witness, not only the perfection of plans now faintly mapped out, but forms and conceptions altogether new, which our present knowledge does not permit us to anticipate.

We shall then see motions working according to a more profitable cycle than that of Beau de Rochas. Perhaps we may even see the dream of the inventor of the rotatory machine taking form in some practical way.

We are yet too much accustomed to grope in the dark. When we wish to make a calculation of the force of resistants, we are compelled to rely on formulas with numerical coefficients not sufficiently accurate, or else pursue the study in a roundabout way. In the matter of the friction of the various parts there are altogether too many unknown coefficients. There is empiricism in every direction.

In general we are too wasteful of the disposable energy. An intermediate shaft, a gear more or less, what matters it? Such is our logic.

On the contrary, the rule should be strictly adhered to, never to add two pieces to a machine when one will answer. If we attempt to change a known arrangement, we should be able to say in good conscience that it is for the better.

I have often been called on to give an opinion on a new piece of mechanism. At first I would find a dangerous resemblance to some contrivance of the celebrated house of Bolt, Screw & Company. On further examination I would discover the differences. Then I would say to myself: "I have not duly appreciated the inventive talents of Messrs Cribeverything & Pilferall," and study the novelty anew. The result has almost invariably been the same. The modification has usually rendered the machine inferior and has had the sole object of circumventing the patent of a competitor. Let us turn with contempt from such endeavors and work honestly and methodically for a progress which is sure to bring its legitimate reward.

* From the French of Baron d'Alten, in Le Chauffeur.

* The authority referred to is undoubtedly Les Secrets de Fabrication des Moteurs d Essence pour motocycles et automobiles par Georgis Knap—Troyes, 1899.—Note by Translator.

* Protective casing.

AGRICULTURAL IMPLEMENTS IN SOUTH AFRICA.

THE possibility of extending our market for agricultural implements in South Africa is suggested by the following article written by a prominent merchant of the Orange River Colony, and published in a recent number of The British Trade Journal, just received at the Treasury Bureau of Statistics. Commenting upon prospective trade opportunities in South Africa the writer says:

"I think all are agreed that now the British flag is hoisted in Pretoria, declaring unmistakably to the world Britain's supremacy from Cape Town to Zambesia, symbolizing security, justice, and equality, that that country will soon enjoy an unprecedented era of prosperity. I would warn our manufacturers, especially agricultural implement makers, and those in kindred trades, to be first in the market. It appears somewhat invidious to single out particular articles for special mention, so great will be the demand for all classes of merchandise; yet it is imperative in the interests of agriculture and agricultural implement makers to state a few facts that have come within my personal experience. It has been too much the custom to send out to South Africa the same class of implement that is selling in this country. Such a policy is stupid and ruinous.

"To begin with plows. The sale of these is practic-

ally unlimited, yet go to any store in the Orange River Colony and you will find for every English-made plow three or more from American and other foreign makers. Farmers declare in favor of American plows because they are lighter yet equally strong, less complicated, lending themselves more readily to the undulating nature of the land. They are better designed than the average English plow. The American plow does not get out of order so readily as the English-made plow, for the simple reason that it is less complicated, and has not so many springs. It is very possible that under new conditions there will be an opening for steam plowing. A few sets are already working successfully in the Transvaal.

"With the exception of a disc roller, harrows and rollers are not much used as yet. I think there should be a future for the disc roller in breaking up newly-plowed land; and there is a great extent of new land broken up every year for maize, on which the disc roller should be very effective. . . . The few I have seen were of American make. Drills and sowing machines should be cheapened and simplified as much as possible. There can be but little doubt about the future demand for these, because great and rapid improvements will be made in the methods of farming out there once the country is settled down to its normal self, and after this war there is bound to be a large influx of new blood.

"For reaping and binding machines there is a large market, so far scarcely entered upon by home manufacturers, for up to the present time they have been supplied almost exclusively by American makers. The potential market for these machines is very great. . . . Makers should give machines a good finishing off with paint. Paint goes a long way in South Africa in helping to sell anything. Above all, they must not forget to provide duplicate parts at reasonable prices, procurable at convenient stores.

"Threshing machines are mostly of British manufacture. Yet here again there is room for vigilance, for I have heard that one or two American threshing machines have been introduced. The advice offered as to lightness and compactness of reapers and binders applies with even greater force in the case of threshers.

"The demand for portable engines has been great in the past, . . . but I think the demand in the future will put into the shade that of the past, not alone for threshing, but in every other direction where engines are necessary for the developing of a new country. . . . It is the duty of our manufacturers to prepare for the great inrush of trade that must follow the war."

EXCAVATIONS AT TELL EL-HESY, THE SITE OF ANCIENT LACHISH, SYRIA.

THE mound of Tell el-Hesy is situated a short distance northeast of Gaza. In 1890 excavations were commenced here by Dr. W. M. Flinders Petrie on behalf of the Palestine Exploration Fund, and subsequently continued by Dr. W. Bliss, who named it "A Mound of Many Cities." The exploration led to the identification of the site as that of Lachish, and this has been subsequently confirmed by the discovery of a cuneiform letter written by Zimride, a governor of Lachish.

Unfortunately the Wady Hesy, or rather its branch, the Wady Muleibah, which joins it here, is a torrent during the winter rains, and it has undermined one side of the ruins. The other sides of the mound are less steep and the surrounding soil and the top of the mound was cultivated by the Bedawin, so that it was only on its steeper sides that Dr. Petrie could make excavations without the need of buying out the crops and of restoring the surface of the land to cultivation. The hill of ruins is about 300 feet each way. It occupies the natural crest of the ground between the small drainage valleys. The nature of the soil aggravates the scouring action of the rainfall, as it is a deep bed of sand with a cap of clay on the top of it, hence the rain cannot penetrate the ground gently, but is shed off to the small watercourses which have already cut through into the soft sand resulting in a strange furrowing of the ground.

The excavations, carried downward 60 feet from the top of the Tell, to the rocky platform of the original site—60 feet above the stream—revealed a regular series of ruined cities, one above the other, eight or nine in number. The uppermost of these ruined cities belongs to the later Jewish period, representing the city destroyed by Nebuchadnezzar, below which were the ruins of the city besieged by Sennacherib in B.C. 701. Below this again were the ruins of an older town, probably of the age of the Judges.

TELL EL-HESY: A MOUND OF MANY CITIES.

At a still greater depth is the yet older settlement of the pre-Israelite age of the Amorites. The ruins of this portion were very carefully explored, and show that the Amorite city was a fortress of great strength, "walled up to heaven." The walls were over 20 feet thick and built of mud bricks, sun-dried. When such buildings fell into ruins the roofs and upper portions of the walls resolved themselves into a mass of crumbling earth, which effectually protected and preserved the lower portion of the houses, as well as all but the most fragile of their contents. On these "heaps" [Jer. XXX., 18] of rubbish the subsequent inhabitants built their new city; and so, as city after city fell into decay, it made a foundation for its successor, and buried its own records, to be unearthed by explorers.* In this portion Dr. Bliss found the remains of the residence of the governor, with a kind of primitive barrack before it. In one of the excavated chambers of this building was found a small clay tablet, in shape and style of writing resembling those found at Tell el-Amarna. This tablet is most important, as it shows that the cuneiform writing was in common use in Palestine about 1400 B.C., a century before the conquest by the Israelites.

The History of Lachish.—From the depth of the accumulations Dr. Petrie considers that the town was probably founded in the seventeenth century B.C., thus corresponding to the beginning of the Eighteenth Dynasty, the age when Egypt began its foreign conquests, and when the Syrians would find the need of massive walls to resist the invaders. The remains of the Amorite walls are considerable. We know that the Amorite cities were almost deserted, and that rude huts of the stones of the stream stood in the place of brick and stone work, and that the wind-swept desolation of the alkali burner's ground shows when even the barbarous dwellers had left the place. Of the time of the Judges there is no building to be traced. The first mention of the fortifying of Lachish is that of Rehoboam, in whose list of fenced cities it occurs. Dr. Petrie says that this wall dates from 970 B.C. It is not likely that David or Solomon would fortify places so near home; the Jewish kingdom had too much vitality in it to need defenses in its midst; and it was not until the weakened power of Rehoboam laid him open to foreign invasion that strongholds were needed within the country. The site was very likely inhabited, however, so soon as the kingdom was well established. The slabs bearing pilasters in low relief are about the most important objects found at Lachish. They probably date from the time of Solomon and they show for the first time an example of early Jewish architecture. The elements of the form are of great value in estimating what Jewish architecture, and particularly that of the Temple, have been. We see on this slab at Lachish the earliest type of the Asiatic volute, and glean from its simple and primitive outline whence the origin of the form arose. The use of ram's horns to decorate a pillar is much like the bull's skulls affixed by the Greeks to the architecture of their buildings. The

VIEW ALONG THE EAST FACE OF TELL EL-HESY.

* Dr. Petrie estimated the average rate of accumulation on this site at feet per century.

shaft of the pilaster is doubtless more sloping than would be the case in pillars, but it suggests that the pillars were greatly tapered in proportion. The original purpose of these slabs remains a mystery.

THE STORMING OF LACHISH, WITH SENNACHERIB RECEIVING THE SPOILS AND CAPTIVES.

This fine series of sculptures from the ruins of Sennacherib's palace at Nineveh, now in the British Museum, represents the assault and surrender of Lachish [2 Kings xviii., 13, 14; and xix., 8]. It was a stronghold of the ancient Amorites, which regained or retained its importance in the time of the Judean monarchy, having been fortified by Rehoboam [2 Chron. xi., 9; 2 Kings xiv., 19; Mic. i., 13]. It was one of the sites reoccupied by the restored exiles after the Babylonian captivity [Neh. ii., 30].

OBVERSE.

REVERSE.

CUNEIFORM TABLET FOUND AT LACHISH (TELL EL-HESY).

It is addressed to the Egyptian commander-in-chief, and mentions Zimrida (Prince of Lachish), otherwise known from the Tell el-Amarna letters (and Abish- [?] yarami) apparently a Canaanite prince who wrote the letter; but little more can be made of it at present.

In the first portion of the bas-relief we see the "fenced city" on its "heap" [Jer. xxx., 18], its towers filled with archers and others, who rain lighted torches upon the wooden cars under cover of which the battering-rams are worked, and upon the tall wicker screens; behind which bowmen and spearmen and slingers are assailing the defenders.* Here and there are scaling ladders reared against the walls. From the principal gate captives are issuing; and in the immediate foreground two soldiers are in the act of impaling a youthful prisoner, side by side with his father and brother. It was an atrociously cruel mode of execution, practiced by the Assyrian kings on important captives, and still in vogue among the Turks until quite recently. Herodotus related that when Darius took Babylon, he impaled about 3,600 of the chief men of the city [iii., 159] (iii.). In the second portion of the sculptures Sennacherib sits on his splendid throne of bronze and ivories, while his great officers present the prisoners from the fallen city. Above is the inscription: "Sennacherib, King of the World, King of Assyria, sate on a throne and caused the spoil of Lachish to pass before him."

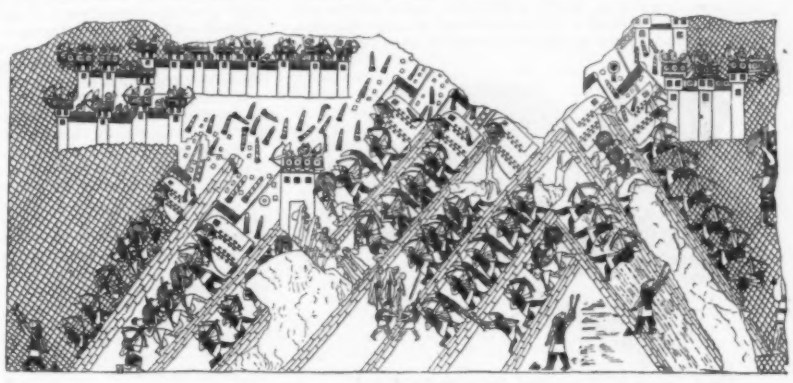
The victorious monarch grasps bow and arrows, speaking symbols of his warlike prowess and recent success [Gen., xlviii., 22; Isa. v., 28; 2 Kings, xix]. Behind the throne stand two eunuchs, holding fly-flaps over the King's head; and behind them is a large tent, over which is the inscription: "Tent of Sennacherib, King of Assyria."

Below is the King's chariot with its attendants, one of whom carries a state umbrella; and on the left, some captives are being despatched. Palms, vines, and olives adorn the landscape. The distinctly Jewish type of face of the inhabitants of Lachish should also be noticed.

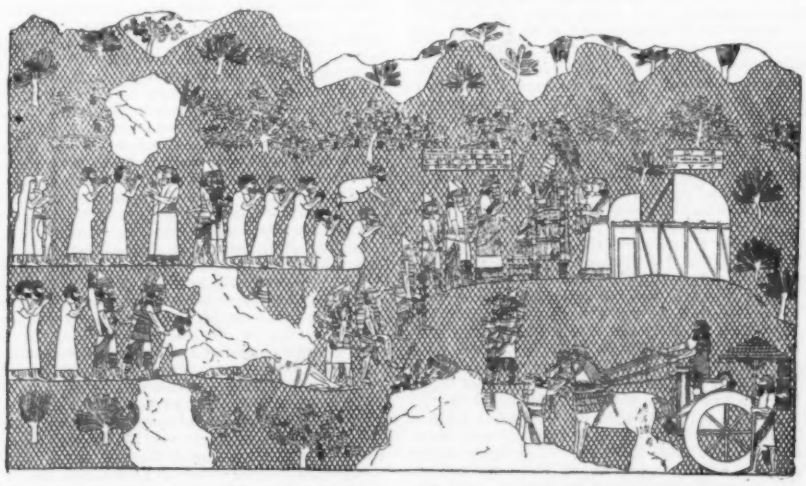
During his excavations Dr. Petrie discovered the steps and guard house of the great gate of Lachish, through which the prisoners are represented as passing to surrender.

The excavations of Tell el-Hesy thus far conducted give a most striking corroboration of the historical records of the Bible [see Light from the East, by the Rev. C. J. Ball, M. A.].—Monumental Records.

PILASTER CARVED.



ASSAULT OF SENNACHERIB ON LACHISH.



SENNACHERIB RECEIVES THE SPOILS AND CAPTIVES FROM LACHISH.

* Note the discharge of water from within the cars upon the battering-rams, apparently to prevent them from catching fire.

THE RECENT ECLIPSE AND ITS LESSONS.

THE observations made during the eclipse of May 28 last seem to have been great in number, and of very absorbing interest. Mr. Maunder, in the current number of Knowledge, writes: Without dwelling at length upon the beautiful detail both of corona and prominences shown on the Astronomer-Royal's photographs, a comparison of his Indian and Portuguese negatives teaches a very significant lesson. Valuable as each series is in itself, it is not too much to say that each has a double value in its comparison with the other. . . . The closing in toward the equator of the great extensions, the diminution of structure in the lower corona, the greater separation of the polar plumes, and the greater amount of general diffused, amorphous coronal light, as seen in the eclipse of 1900 when compared with that of 1898, is most evident. This year's eclipse was emphatically an eclipse of the sun-spot minimum; it reproduced the general form—it is scarcely an exaggeration to say, even the detail—of the eclipses of 1878 and 1889, at the two preceding minima with astonishing fidelity. It is gratifying to learn that greater accuracy was displayed in drawing the corona than in any previous eclipse. It is a curious and unexpected detail of evolution that not only is there a progress in artistic ability and truth in the individual through the means of his personal practice, but there is also in the race. The same sort of thing has been noticed before now in drawings of the surfaces of moon and planets. Men see more easily and depict more faithfully, faint, difficult or minute markings than was done fifty or a hundred years ago. Indeed, the trend toward uniformity has been so strong as occasionally to draw sharp criticism and hints of the effect of bias. That could not be the case here; drawings made by observers separated from each other by scores or hundreds of miles and having not the slightest means of communicating with each other have by their resemblance borne the most striking testimony to the skill and fidelity of the artists. There has been a complete absence of the grotesque and extravagant designs that were common enough a generation ago. Some of the drawings, too, were made with the most astonishing rapidity. Miss Stevens', for example, issued with the July number of Knowledge, was the result of less than forty seconds devoted to the scrutiny of the corona, and yet—though not intended to exhibit in particularity the details of the corona—it could be scarcely surpassed as a representation of the general effect. This improvement is a matter for the greater congratulation since it is manifestly due to greater skill in the observer, and the observer must always be more important than the instrument. The improvement in the delineation of planetary surfaces might well have been ascribed to the improvement of telescopes, but that cause cannot enter into the case of drawings of the corona made with the naked eye.

RAILROAD FORESTRY.*

By J. HOPE SUTOR, General Manager, Ohio & Little Kanawha.

THE reputation which railroad officials have deservedly earned for promptness of action, clear-headedness in emergencies, and foresight in anticipating the inevitable, is clouded by a condition which it is singular they have not seriously considered. A reason may exist in the fact that, from the nature of the profession, a railroad official cannot be a recluse, and the active operating officer must mix very much with the public, from whom he absorbs many popular fallacies and becomes a sharer with his fellows in much of the indifference which is manifested in economic questions. While, therefore, in various ways, the profession practices the most commendable economy, to increase the revenues, it has given no attention to a waste which, while not a source of present or immediate loss, will prove a heavy drain in the near future.

The last published report of the Interstate Commerce Commission is for the year ended on June 30, 1898, at which time the total mileage of all classes of tracks of the railroads of the United States is given as 247,532 miles. The territory covered by this association includes the whole of group III. and portions of groups V. and VI. of the commission classification of railroads, making about 15 per cent. of the nation, or say 37,000 miles. The total cost for renewal of cross-ties in the United States, during the year ended on June 30, 1898, was $24,769,684, or about $100 per mile; this does not include labor, and is a very low average. Apportioning this cost to the territory covered by this association, the expense was $3,700,000.

Computed upon the low average of 2,500 ties per mile, 92,500,000 ties are in the track in the association territory; and as the average life of the ties is perhaps about eight years, nearly 12,000,000 ties are required annually for renewals. The size of the tie is not uniform, but a common size is 6 inches thick, 8 inches face, 8 feet long, making 32 feet board measure of timber per tie, or 380,000,000 feet board measure of timber annually cut into cross-ties alone in the association territory. As many ties are much larger, the gross amount is actually in excess of the above quantity.

Cross-ties, however, do not constitute the only lumber consumed by railroads. There are 28,000 miles of single main track in the association territory, upon which at least thirty telegraph poles per mile are used, or 840,000 poles; as the life of a pole is only ten years, 84,000 must be replaced in each year. In addition, bridges, trestles, cars, buildings, fences, etc., take large quantities of timber, and in the Central Association territory alone, the annual consumption of lumber, by railroads, aggregates several hundred million feet. The quantity cannot be estimated with accuracy, as the roads vary in topography, and the substitution of iron and stone is being made as ability permits.

When the territory of the United States is considered, the quantity of timber cut is astonishing. There are 620,000,000 cross-ties in the track of the railroads of the country. Many of these are soft wood, which lasts from five to seven years only, so that the average life of ties throughout the nation cannot exceed seven years. Nearly 90,000,000 ties are, therefore, required annually for renewals, and at the low average board measurement already stated, not less than 3,000,000,000 feet of timber is used annually for cross-ties alone. To this must be added the lumber for bridges, buildings, cars, etc., and the quantity exceeds our ability to comprehend.

The railroads are not the only users of lumber, for other people must have houses, furniture, bridges, conveyances, etc., and this market is greatly in excess of the railroad purchases. The census of 1890 states that the total consumption in that year (ten years ago) was 23,766,000,000 feet.

The necessities of the railroads demand that toughness and elasticity shall distinguish the timber em-

* An address delivered at the July meeting of the Central Association of Railroad Officers at Louisville, Ky.—From the Railway Age.

ployed, so that only selected timber can be used. Lumber men assert that not to exceed 300 white oak crossties can be cut from one acre of natural forest and in many localities the yield will not exceed 100. Such trees must be from forty to sixty years old, and at the highest yield per acre 40,000 acres of forest must be culled of its best timber annually to supply the ties in the Central Association territory. Where the softer woods are used the yield per acre is much greater, yet it is a conservative estimate that 200,000 acres of forest are cleared every year to supply the demands for crossties alone.

Railroad officials are deeply interested in the perpetuity of the material necessary for the maintenance and operation of their property. They are constantly seeking improved methods to reduce expenses, knowing that money saved is money earned. The form of the rail section and the weight of rail per yard have been scientifically studied and discussed; the contour of automatic couplers has had the most minute technical consideration, and in many important articles of construction and operation, the details have been logically analyzed, tested and improved. Within the experience of many operating officers, the cost of rail renewals exceeded that of ties many fold; now the condition has been reversed. While the quality of rails has been improved, tie renewals exceed the cost of rails, and are increasing, yet the cause is not being noted nor any measures being instituted to remedy or improve the situation. Timber is becoming scarce, and that of the best quality, so that inferior timber, which supplies inferior ties, is becoming the sole source of supply. No material has yet been found as a substitute for the wooden tie, and no satisfactory economical method of preserving the life of the wood or prolonging its durability has been discovered, and, excepting the minor questions of properly seasoning and piling, the use of the tie plate, suitable ballast and perfect drainage, with incidentally climatic conditions, no serious consideration of the future tie supply has been had.

Nearly all the country included in the territory of this association has been settled and developed within a century. Ohio, the oldest of the States, will not celebrate its centennial until three years hence; and when it was admitted to statehood it had less than 50,000 inhabitants. Nearly all the land east of the prairie regions of the Mississippi Valley was heavily timbered, and in the Eastern States the records preserved show that fine timber grew to the very edges of the bays and rivers. If the destruction of all this wealth, the growth of centuries, has been essential for one century's development, to what degree of distress will our successors be reduced in maintaining it? Surely reason will rap the knuckles of our children, and the sentence of Sinai will be fulfilled in visiting the sins of the fathers upon the children unto the third and fourth generation.

The experiments which have been made, in a very limited manner, in tree planting on railroad rights of way, have not been satisfactory, and cannot be on account of the limited width of such strips. Forest conditions must prevail, and these cannot exist on the right of way. Trees for timber must have trunks and not limbs, and to overcome the natural tendency to make limbs they must be grown close together, when each will seek to outgrow its fellows and reach the higher altitudes, where it can "expand." This effort on the part of each plant is commendable from the standpoint of the cultivator, and is the reward for his labor and patience.

Along every railroad are tracts of land not well adapted to cultivation, which would make desirable wood lots upon which trees could be grown for the timber required in the different railroad departments. Such plantations would perhaps be more secure if not adjacent to the road, as fire is an enemy to forestry; yet the wood lot need not be so far as to make access difficult or expensive for protection, cultivation, and supervision. Upon a plantation of catalpas, the trees should be placed 4 feet apart, which would require 2,700 plants per acre. Not all the 2,700 trees would mature, nor is it desirable that they should, but about one-fourth, or 700, would. In fifteen years the yield should be four ties per tree, or 2,800 ties per acre, and by judicious cutting a rotation of timber can be obtained. If the white oak tie is desired, the growth would not be attained under forty-five years.

The financial aspect of the undertaking is not at all unsatisfactory. A plantation of catalpas, in Kansas, in seven years began to reimburse the owner by thinning, the trees having attained a height of from 18 to 20 feet, and making two fence posts each, and the experience has been duplicated in many places. No one will assert that first-class ties will be procured fifteen years hence at present prices. If the cost per tie in 1915 be placed at 75 cents, a very low estimate, the value of an acre of ties, cultivated as suggested, will be $2,100, with a life for the timber grown four times that of the best white oak. The land purchased will still be the property of the railway, but deduct its cost, say $50 per acre, and $3 050 remains as the result of the investment, or $135 per acre per year as the value of the crop. What farmer can point to a yield so satisfactory? The expense will have been so slight that the value of the thinnings will be found sufficient to more than pay for the attention required. But it may be urged that fifteen years is a long way off, and that we should take "no thought for the morrow, for the morrow shall take thought for things of itself. Sufficient unto the day is the evil thereof." The advice may be good philosophy, but it is very indifferent practice in railroad affairs, and is not observed by any railroad official.

The cultivation of forests would not be unattended with expense and supervision; it is a kind of agriculture and not merely the planting of seeds or plants; they must be cultivated and cared for systematically and intelligently until they are sufficiently large to shade out grass and weeds, until which time grass and weeds must be destroyed; they must also have protection against fire and live stock, and be managed as an investment. In proportion to the extent of the undertaking it would require a forester who should have absolute control of the forestry; section men should be instructed by him how to protect the growing timber, not as a part of their regular work, but in the manner they now care for the telegraph line, in emergencies, until the lineman arrives. Such service would not be expensive, and the forester should be required to keep detailed records of the successes and failures of his department for future guidance.

The National Government is ready to extend a helping hand to any railroad which desires it. The Division of Forestry of the Department of Agriculture will give practical assistance to tree planters in the selection of the right tree to plant, and in planting them rightly. The division will make examination of the ground proposed as a forest, prepare a plan for planting and caring for a plantation, which will best promote and increase the present value and usefulness of the land to the owner, and develop and perpetuate a plantation of forest trees upon it. Upon the completion and acceptance of the plan by the owner, the division will supervise the execution thereof, so far as may be necessary. If the area does not exceed five acres no charge will be made for services, but the division will not participate in the expense of planting and caring for a plantation except to defray the salary and expenses of its representative. If the area exceeds five acres a preliminary visit of inspection, if required, will be wholly at the expense of the division. If a plan is made and accepted, the owner must pay the expenses of the division officials according to a printed schedule of cost of services, which will always determine the amount of the anticipated expenditures. The department in every instance reserves the right to publish and distribute the plan for the information of others.

The general government has sounded the alarm, and as loyal citizens we should respect the warning. The progressive ideas which characterize railroad officials should cause them to be zealous advocates of a subject which concerns them so intimately and to support the State and national regulations respecting forestry. There is no way in which the present vague and imperfect knowledge of the subject can be changed into an active, earnest interest in forestry except by an accurate acquaintance and agitation of the question. If railroad men become aroused to the importance of forestry, not only to the service, but to the public of which they are a part, and with whom they must suffer any general condition, a sentiment will be awakened which will work wonders and cause future generations to rise and bless us.

DENDROBIUM × DALHOUSI-NOBILE.

THIS fine hybrid was shown by Sir Trevor Lawrence, Bart. (gr., Mr. W. H. White), at the Royal Horticultural Society on June 5, when the Orchid Committee voted it an Award of Merit, although many of the expert orchidists who saw it thought, in view of the distinct character of the cross, as well as on account of the

DENDROBIUM × DALHOUSI-NOBILE.

beauty of the flowers, it might well have been honored by a first-class certificate. The cross was originally made by R. Brooman-White, Esq., of Arddarroch, the species employed being D. Dalhousieanum (pulchellum, Roxb.) and D. nobile.

Although the inflorescences on the plant exhibited were few-flowered, there was indication in the attempted racemose formation of the flower-spikes that ultimately the plant may bear flowers in the same way as D. Dalhousieanum.

The growth of the plant resembles D. Dalhousieanum in a great degree. The flowers have the sepals and petals white at the base, the outer two-thirds tinged and veined with rose-purple. The broad shell-shaped labellum has a bluish-white base, a deep claret-colored disk, surrounded by a white zone, the apex being bright rose color. It is one of the most distinct and showy hybrid Dendrobiums yet raised.—The Gardeners' Chronicle.

CULTIVATION OF COFFEE IN INDIA.

AT the end of 1898 there were 281,570 acres of land under coffee in India, all with the exception of 549 acres in southern India. The cultivation of coffee is, in fact, restricted for the most part to a limited zone in Mysore, Coorg, and the Machas districts of Malabar and the Nilgiris. About 45 per cent. of the coffee-bearing area is in Mysore, where there were 128,079 acres in 1898. The plant is grown on 128,410 acres, forming another 45 per cent. in the British districts of Coorg (82,575 acres), the Nilgiris and Malabar (45,835 acres). If to these two areas are added 6,384 acres in Travancore and Cochin, we find 93 per cent. of Indian coffee concentrated in the elevated region above the south-western coast. Mysore, Coorg, and the Madras districts contain 97 per cent. of the coffee-growing area. According to the United States Consul at Bombey, in the Madras Presidency, cultivation on an extended scale is confined practically to the two districts already mentioned, and to Salem and Madura. The only other province in which coffee is grown, except experimentally or to an insignificant extent, is Burma, and the cultivation there, mostly in Toungoo, is very limited. The area in Madras, after a reported contraction in 1896 and 1897, again expanded in 1898 to the level of 1894 and 1895. In Coorg, the area reported in each of the last three years is much beyond the average, but in Mysore it has been reduced approximately to the level of 1892. As regards the production of coffee, the yield in 1898 was about 23,750,000 pounds, that of 1897 having just exceeded 24,000,000 pounds. The production of both years was exceedingly poor, following a small yield in 1896. The poverty of the crop in 1896 and 1897 was due in the main to adverse seasons in Mysore, Coorg, and Travancore. In all three cases there was a recovery in 1898, which was, however, incomplete in the case of Mysore, but to set against this recovery the Madras crop was a single failure. Since 1897 the fall in prices has removed the stimulus which had been given for a few years to the expansion of the coffee-growing area, and disease has combined with adverse climatic conditions to reduce the yield. According to returns there were, in 1898, 25,900 persons employed permanently, and 88,550 temporarily, on the coffee estates, making a total of 114,480 persons, which is equal to one person to 2·46 acres.—Journal of the Society of Arts.

MICROBES—WHAT ARE THEY?

By HENRY G. GRAHAM, M. D.

1. Detection of Protozoa in the body.—The presence of the protozoa in the fluids of the body is readily ascertained by the sight alone, their form being characteristic. This is true not only of the adult, but of the elementary form as well. Certain embryonic forms, however, so nearly resemble blood and lymph corpuscles that it may become necessary to resort to some means to distinguish one kind of corpuscle from the others.

By elementary protozoa is meant the microscopic spherules, often so minute that they approach the limits of visibility, from which spring, upon the conjugation of the adult organisms, the embryonic forms.

Two agents that may be employed to distinguish blood corpuscle, lymph corpuscle, and embryonic protozoon from each other are a saturated solution of caustic potash and pure acetic acid.

If the first is brought in contact with a blood corpuscle, the latter is at once destroyed, and the nuclei, if any are present, quickly disappear.

A lymph corpuscle will gradually and evenly expand, expel its granular contents, and again contract, the stroma remaining intact.

In case of an embryonic protozoon, the corpuscle disappears only after a time and the nuclei persist indefinitely.

When the adult protozoon has become encysted, contact with caustic potash does not destroy such form, even after many days.

Application of acetice acid to blood corpuscles shows the presence of one or more nuclei, while upon embryonic protozoa no effect is produced.

From embryonic protozoa contained in the various fluids of the body mature organisms may be developed in proper culture media. Elementary protozoa on solid culture media produce other elementary protozoa.

Mature and immature protozoa may sometimes be distinguished by the coloring matter they develop. This is usually blue, bluish green, or brown.

When found in the urine, embryonic protozoa closely resemble the pus corpuscles derived from the blood. They are distinguished by the means given above and by the use of nitric acid. The latter will show the presence of albumin if the pus corpuscles are blood corpuscles. If the pus corpuscles are elementary protozoa, the presence of albumin will not be shown.

As seen in the fluids of the body, the higher forms of the protozoa often exhibit a very slight rotary motion imparted by a filament usually carried beneath the organism.

The corpuscles derived from the blood are almost uniform; those derived from the protozoa are more variable in size.

In fluids the protozoa retain their form for many months—in fact, indefinitely—while blood corpuscles, under the same conditions, speedily disappear. In urine, actively motile protozoa have been found nine months after it had been drawn with a catheter, and been kept free from contamination.

2. The Bacteria, Elementary Forms of Higher Organisms.—After a protozoon has disintegrated in a fluid, upon its former site are found:

A. Minute microscopic spherules—cocci.
B. Bacilli or spirilla, or both.
C. Embryonic protozoa.

That the first are elementary forms of the protozoon, and not foreign bodies, may be shown as follows:

In case of the Monas fluida and of some other infusoria, the protoplasm contained within the ectosarc has floating in it one or more large nuclei. Within these bodies are other and smaller nuclei, and these last contain the minute microscopic spherules or cocci which are the ultimate forms that can be discerned when the organism disintegrates.

If caustic potash is brought in contact with Monas fluida the ectosarc bursts, and the protoplasm, with the large nuclei floating in it, is set free. Presently these nuclei burst, when other nuclei are set free. Finally, when these last nuclei are broken up by the continued action of the solution, great numbers of the microscopic spherules escape and are seen to be very actively motile. That this is not a mere Brownian movement is shown by the fact that when similar bodies and foreign bodies are found just within the ectosarc of a protozoon, the first exhibit this same movement, while the second do not. We shall endeavor to show that these minute spherules are the familiar Staphylococcus, pyogenes albus.

It will be observed that this body, the fourth within three concentric circles, was shielded by three successive barriers against the approaching caustic solution. This is worth remembering when we come to consider the manner in which this microscopic spherule is protected from the action of the juices of the alimentary canal. It should also be remembered that this spherule continues actively motile for a considerable period even in a saturated solution of caustic potash. Is it not possible that while in this condition it may enter a villus of the intestine unaided by any save its own motile powers?

If it were a foreign body, we should expect to find it within the outer instead of within the inner zone of the protozoon. The spherules are of uniform size and appearance and are always present. This is not true of foreign bodies.

These microscopic spherules, whether within the central nucleus or just within the ectosarc, reproduce themselves by fission. In an unfavorable environment, the nuclei of the protozoon disappear, the outer cap-

sule persisting. This is usually in the form of a circle or oval, and incloses a teeming mass of microscopic spherules.

Such bodies are always to be found in the saliva of persons who drink water containing living protozoa. They must not be confounded with epithelial cells, some of which they closely resemble.

The following is offered as proof that the bacilli, spirilla, and beggiatoa are derived from the protozoa. The forms called cladothrix, streptothrix, leptothrix, and myconostoc may be seen to be derived from the same source.

A small quantity of filtered solution of Mellin's food is added to pure water in a vessel. Monas fluida is now transferred to this culture medium. This is best selected from a colony in which most of the organisms have become encysted. After twelve hours, by means of a cover slip, the surface growth is removed to a slide. Here and there some specimens of the monad will be found that had risen to the top of the fluid. The ectosare is spread out on its surface, where it will be seen to have become transformed into a mass of bacilli. These masses increase in size at the periphery until in from twenty-four to forty-eight hours they coalesce and form a pellicle on the surface of the water.

There are certain protozoa that remain immersed in the fluid in which they grow, and simply throw out diverticula, just as Amæba princeps extends its pseudopods. These diverticula are often quite long and sinuous. They soon become fixed, and after a time the protoplasm is transformed into a mass consisting for the most part of bacilli. A hyaline substance first intervenes, but after a time this disappears, setting the bacilli free.

In old colonies protozoa may be found teeming with a mass of bacilli and spirilla. Here, the conditions being unfavorable to the development of the embryonic protozoon, that body is transformed into a lustrous, slightly motile bacillus or spirillum, or the protoplasm of the outer zone disappears, the nucleus alone continuing under these lower forms. In one infusorian the nucleus and its modified forms may be distinguished from the rest of the body with the use of a stain. Carbol-fuchsine and methylene blue stain the spherule rod or spiral red, the surrounding protoplasm blue.

A spherule rod or spiral is always to be seen within an embryonic protozoon. If the spiral is the form present, every protozoon contains one. This would not be true if its presence were accidental.

The bacteria seen within a resting protozoon are usually all spherules, all rods, or all spirals, and they may lie dormant or be very actively motile. Such a resting form, filled with a mass of actively motile spirals, if seen in the tissues of the body, would appear as a formidable pathogenic agent. After the ectosare has broken down and has disappeared these spherules, rods, and spirals remain in clumps and continue to multiply. This is the origin of the cluster of bacteria usually found in urine in diseased conditions. Sometimes the ectosare still incloses them. In a few instances, the adult protozoon is found in urine just as it appears in water except that it is non-motile.

Old colonies of Monas fluida will show to good advantage the microscopic spherules; Cofeps hirtus, the lustrous rods and undulating mass of spirals.

To study the long, delicate, serpentine filaments often seen floating in water, Paramecium aurelium is selected.

The organism is placed between a slide and cover slip and the excess of water removed by means of bibulous paper. Evaporation is allowed to continue for some time after the infusorian has become quiescent. While under focus the cover slip is slightly displaced. If enough time was allowed for the organism to become slightly adherent to the surface of the slide and of the cover slip, the mass of its body will now be seen to be in one place, and the long, slender, delicate, almost invisible filaments, in a compact mass and lying parallel to each other, will be seen on the former site of the protozoon. These afterward develop into very long, delicate, slightly motile, serpentine filaments. These are probably identical with Leptothrix buccalis.

The third form, or elementary protozoon, is always found on the site where an adult organism has disintegrated.

The protozoa propagate themselves in three principal ways:

A. By division of the adult organism.

B. By bud formation and extension.

C. By development and division of their contained nuclei.

What appears as a fourth mode is only a modification of this last. Two adult protozoa move upon each other like two revolving cylinders, their surfaces in contact with each other. This rasping results in an extrusion of a portion of the contents of each protozoon, and this consists in embryonic protozoa floating in a jellylike mass of protoplasm, the whole resembling the spawn of fishes. These embryonic protozoo are bacilli. Each bacillus contains either one or two nuclei, and these are imbedded in protoplasm, the whole being surrounded by a capsule. These bacilli are all of uniform size, and are often very numerous. They are quite lustrous and present the appearance of newly formed protoplasm. In size and form they resemble the colon bacillus, the bacillus of typhoid fever, the Bacillus lanceolatus, etc., according to the kind of protozoon and the conditions under which it is grown.

Two organisms will come together and may be seen by the hour moving upon each other, the surface of one gliding upon the surface of the other, the jellylike mass described above collecting round the circle within which the organisms move. After the newly formed ring of protoplasm, with its contained embryos, has been greatly augmented in this manner, one protozoon escapes from the inner ring, the other usually continuing to move round and round within the now constantly narrowing circle Finally, the other protozoon escapes, and the site it occupied is speedily obliterated. If the culture medium continues favorable, the young embryos develop into adult protozoa, but if placed upon solid culture media they propagate themselves, producing other bacilli. These in the first few generations retain the capsule, but in later cultures the capsule disappears.

When the protozoon disintegrates, the bacilli derived from the ectosare do not form spores, while those derived from the endosare are spore-forming bacilli. Both kinds propagate themselves indefinitely.

In some of the protozoa the spore-forming bacilli develop into long, delicate hyphæ, having two parallel walls inclosing a lumen filled with spores. If the conditions are unfavorable, the spores bud into hyphæ; otherwise they form other protozoa.

The streptococcus derived from various protozoa may be regarded as a diminutive hypha in which the spores are large and prominent and its walls rudimentary.

A hyphæ may contain terminal or intercalated heterocysts, or both. Within these and within the walls of the hypha the protozoa develop. If the conditions are less favorable, from the nuclei within the heterocysts, other hyphæ are developed. The walls of a hypha may be regarded as a very much elongated ectosare, its lumen as an attenuated endosare. Such a protozoa may be looked upon as a dual organism—at one time more closely approaching the animal, at another time the vegetable kingdom. Such an organism would correspond to the protista of Haeckel. It is possible it was upon the study of some such forms that Zoph established his theory of the pleomorphism of bacteria.

We have now seen that where an adult protozoon has disintegrated we may find microscopic spherules, bacilli, leptothrix, and elementary protozoa. This very much simplifies the study of bacteriology, and, when we remove from the crypt of an enlarged tonsil all these forms, we know that the inflammation depends not necessarily on the presence of a variety of organisms, but of only one kind of organism that of its own inherent motile powers had entered the crypt from which it was subsequently removed.

3. Resistance of the Protozoa to Destructive Agents.—A saturated solution of potassium hydrate and pure sulphuric acid will reduce the protozoa to more elementary forms, but will not destroy the vitality of these forms except after prolonged contact.

When a fluid in which a protozoon exists evaporates, the protoplasm forming its body mass escapes through a rent in the ectosare in the form of minute droplets. These were probably the "minute drops of oil" of Linnæus and of Dutrochet, from which they produce living protozoa by simply passing a current of electricity through the fluid containing them. These minute bodies are frequently found in the urine of persons suffering from disease. They may be found in the fæces, in the pus from suppurating cavities, in the blood, in the saliva, and in the secretions from the pituitary membrane and bronchial tubes.

Boiled in a hermetically sealed flask twenty minutes each day, for three successive days, after two months, the flask having remained hermetically sealed, great numbers of the elementary and embryonic forms of Monas fluida will be found actively motile. Most of them will be free, but a few will still be seen within the resting forms, the ectosare of the latter in a few instances having remained intact. This experiment shows the Monas fluida to be a facultative anaerobe.

The same organism sealed up in a glass tube will survive for eighty-three days, and probably indefinitely, possibly for years.

After remaining for two weeks at room temperature—about 70° F.—in a dry state, not only will the spores retain their vitality, but the ectosare in a few instances will remain intact.

On April 5, 1899, a woman died whose urine, which was drawn with a catheter, contained great numbers of elementary and embryonic protozoa. At this writing (March 10, 1900) many actively motile but small protozoa are present in the urine, which all these months has been kept free from contamination. So long as they continue in this medium they will remain very small and stunted, for, like the northern pine, the more unfavorable the conditions under which they grow, the more they are dwarfed.

In general it may be said of the protozoa that the higher the temperature of the medium in which they exist—up to a certain point—and the more dwarfed their size, the greater is their activity. This is true as well of their elementary and embryonic forms.

In normal urine, at room temperature, under a bell jar, certain of the protozoa will develop typical chains of the streptococcus as well as pus corpuscles. After a time the urine becomes strongly alkaline, the corpuscles break down, forming a viscid mass which pours like pus to which an alkali has been added. These chains are the same in appearance and stain the same as the Streptococcus pyogenes.

From such a culture adult protozoa may be grown by transplantation to proper culture media.

If certain mineral substances are added to a culture of protozoa, the latter will become encysted and will be transformed into siliceous-like bodies that form rosettes of crystalline needles. They impart the same sensation as of sand pressed between a slide and cover slip. It is possible this will explain the cause of some forms of inflammatory rheumatism.

4. Virulency.—Virulency is simple in adaptation of the infecting organism to a new environment. If the new environment is similar to the old, virulency was probably acquired in some previous host. To this class of infecting organisms belong all those that produce disease by direct transmission, as in blood poisoning following the infection of an external wound, or the experimental infectious diseases of laboratory animals where the infection is conveyed by means of a hypodermic syringe. Even here the infecting organism is probably often an elementary protozoon that has been transmitted from host to host, just as the protozoa in their most elementary form may be transplanted many times and propagated on solid culture media for many generations.

If the new environment is unlike the old, virulency is acquired in the immediate host. In other words, the infecting organism must adapt itself to new conditions before it can propagate itself and so produce disease. To this class of organisms probably belong those that produce the various acute infectious diseases. Herein lies the difference between the infectious diseases found in nature and those experimental diseases produced in laboratory animals by the use of the hypodermic syringe. The former, or at least most of them, can not be produced by the methods in vogue in the bacteriological laboratory, while the latter are atypical, and their counterpart is not found in nature.

The contagium, for the most part, finds its way to the blood current through the natural channels, and it is a mistake to imagine that insects—e. g., the mosquito in malaria—are common carriers of disease. The common carriers of the natural infectious diseases are the various protozoa, and the form in which these exist in the body is that known as the bacteria. Eosinophiles and their congeners are the protozoa in their embryonic form. In normoblast and in megaloblast the protozoon is imbedded in a red blood corpuscle. Normoblasts, megaloblasts, giant cells, and elastic fibers, such as are seen in tuberculosis, may be found in old colonies of the protozoa.

That the protozoa are for the most part non-virulent is evidenced by the fact that their presence does not give rise, as a rule, to any disturbance of the vital processes of the host. That they may become virulent, however, is further evidenced by the fact that exceptionally living protozoa are found in the tissues of dead or dying water organisms. These had escaped into the tissues from the alimentary canal of the host and had adapted themselves to their new environment. Their presence in large numbers is incompatible with the continued integrity of the host. In the human being the presence of large numbers of protozoa in a tissue results in inflammation and subsequent sloughing of the part affected, for under the most favorable conditions certain of the protozoa are great pus producers.

When a protozoon enters the alimentary tract of its host, whether it will become virulent or not will depend upon two things:

1. Whether it will by its own motile powers penetrate the walls of the alimentary tract, and so reach tissue beyond.

2. Whether it will adapt itself to a new and ever-changing environment that gradually becomes more and more toxic for the host.

The development of a non-pathogenic into a pathogenic organism is well illustrated by the presence in the tissues of the body of a protozoon that eventually produces malarial infection. Its first appearance gives rise, perhaps, to no new symptoms that would arouse suspicion that an infecting organism is present in the blood or lymph. The probability is that it can be eliminated before it can give rise to any marked symptoms of infection. If, however, it is not thrown off, the protozoon will adapt itself to its new environment, and its continued presence will eventually bring on a pronounced chill. This is probably caused by the bursting of the ectosare of the protozoa and the setting free in the blood current of the nuclear bodies, together with the fluid in which they float. It is probably at this time that the most elementary bodies of the protozoon most vigorously attack the red blood corpuscles and by means of their own motile powers penetrate to their interior.

Even now the protozoon is usually thrown off and the malarial poison successfully combated by the administration of quinine, iron, and arsenic, but it is doubtful if the most elementary form of the organism is ever completely eliminated. These latter are liable to accumulate in various tissues, especially the mucous membranes of the respiratory and genito-urinary tracts, and, as a lower temperature than that of the body is more favorable to their development, it is readily seen why catching cold gives such an impetus to their growth.

These low forms of not only the malarial parasite, but those of other protozoa, collect in the same tissues and for the same reason—viz., that of lowered temperature—and they continued to thrive here despite the most persistent efforts on the part of the rhinologist or gynæcologist to dislodge them. Thus, we can see why a chronic amœbic dysentery cannot be cured and is so difficult to control, and why most operators remove the appendix vermiformis to prevent a recurrence of the trouble. It is probably for the same reason that cancer and tuberculosis are so difficult to eradicate.

If in malaria the organism grows more and more virulent, a simple malarial infection becomes malignant, and symptoms of a general septicæmia may be followed by death.

This most elementary form of the protozoon, which is an exceedingly active little body, and which invades the red blood corpuscles in such great numbers, is probably identical with the Staphylococcus pyogenes albus. If grown upon solid artificial culture media it exactly resembles that body in appearance and staining properties.

Such a body injected into a laboratory animal will produce death in less than twenty-four hours. The dead animal will present the appearance of having died of a general septicæmia, and the organism can be recovered from its tissues (post mortem) and grown upon solid artificial culture media.

I am indebted to Dr. Rare, of the Columbus Memorial Laboratory, for the information that this little elementary protozoon is commonly regarded as a pigment granule.

5. The Protozoa as Morbific Agents.—Elementary forms of protozoa are probably always to be found in small numbers in the blood, lymph, and urine in health. Their presence in great numbers, however, is always indicative of a diseased condition, either general or local. Embryonic and higher forms are not found in the urine in health. These are found, however, in the following diseases: Measles, mumps, scarlet fever, diphtheria, pneumonia, typhoid fever, cerebro spinal meningitis, purpura hæmorrhagica, malaria, ascites, especially of children, general dropsies, chronic nasal catarrh, follicular tonsilitis, bronchitis, cancer, tuberculosis, etc. They are found in metastatic abscesses arising from these acute infectious diseases, and in suppurating foci everywhere of "spontaneous" origin, for some of these "innocent" protozoa, under the most favorable conditions, are great pus producers.

We may expect to find these higher forms in any acute infectious disease in which bacteria are present, except where such disease is the result of direct inoculation, or where the disease is experimental, as in laboratory animals, where the infection is conveyed by means of a hypodermic syringe. These higher forms may be found in the discharge from a diseased endometrium, in the secundines after an abortion, in pus pockets everywhere, as in pyosalpinx, and they are especially abundant in tuberculous abscesses.

Of all the varieties of protozoa—and this is meant to include the monera, rhizopoda, infusoria, and spo-

rozoa—collected in the course of two years from hydrant water and grown artificially, only one has been found that possesses the peculiar staining properties of the tubercle bacillus. This organism does not stain at all with the use of the ordinary aniline dyes; but, if stained by the Ziehl-Neelsen method, the protozoon stains red and the field blue. This is probably the form in which the tubercle bacillus exists in the outside world. Even this organism does not possess this peculiar staining property throughout its entire life cycle. The bacilli derived from it do not always stain red, and in some cases of pneumonia there appear to be transitional forms that possess this staining property only to a slight degree. It is the embryonic form of this organism that is best fitted to show that a certain bacillus is really a product of the organism itself and not a foreign body. This bacillus stains red and the rest of the body stains blue. In an unfavorable culture medium that portion of the embryonic protozoon that stains blue disappears, leaving the red bacillus free. This is probably the process of infection of the lungs in the majority of cases of pulmonary tuberculosis. It may explain the manner of origin of miliary tuberculosis and why certain cases of pneumonia, measles, and pertussis result in a tuberculous infection. The infecting organism does not need to be inhaled from the outside world, but is already present.

The pneumococcus of Fränkel is an elementary protozoon in which the capsule represents the ectosarc, the nuclear body or bodies with the surrounding protoplasm the endosarc of the mature organism. On a solid culture medium this capsule will after a time disappear, leaving only the nuclear bodies to propagate themselves. These represent the most elementary form of the protozoon.

Among the protozoa, the adult organisms propagate themselves by division of the body mass. The same is true of all the forms derived from them—the bacilli, spirilla, and the minute spherical bodies that constitute their most elementary form. The multiplication of each form continues so long as the culture medium remains unchanged.

In general, it may be said of the bacteria that the spiral is the product of an earlier form, the bacillus and leptothrix, the later products of a more mature form of the protozoon.

The bacteria, then, are low forms of life derived from the protozoa.—N. Y. Medical Journal.

TAKING A DEGREE IN CHINA.

"KNOWLEDGE is power." The proverb is Western, but in China alone is it commonly and actually the case. The trader, the laborer, the soldier, are scorned and held in national and general contempt. In the scholar are focussed all Chinese ideas of honor and greatness. "Chu hain jin neng"—"Employ the able and promote the worthy" is the keynote of the system, whereby for some thousand years all the posts in the government of the Celestial Empire have been filled by competitive examination. By his knowledge and success in the Imperial examinations for the Triple Degree the poorest boy in China may become a mandarin. The system comprises a series of examinations the greatest in the world. Beside the Imperial examinations of China the sum total of University examinations in the Western World sink into insignificance, both in number and character. They are open to all Chinese, save monks, actors, and menials. The tests are threefold, roughly corresponding to the Western matriculation, intermediate, and final examinations. The subjects of the papers comprise the whole recognized Chinese literature. And the extent of the Chinese classics is sufficient to stagger humanity when confronted with them on setting forth to become master thereof. The whole of these the student is required or supposed to commit to memory. The first examination is held in about seventy centers in each of the eighteen provinces of the Empire. At each center between 1,000 and 2,000 candidates present themselves for examination for the degree of "Budding Genius." Of the 2,000,000 candidates only one per cent. successfully pass the ordeal. . . . As the day draws near, the streets are thronged with long-robed, large-spectacled gentlemen, to the number of some 10,000 or 15,000. In their wake follow armies of camp-followers—traders, painters, scroll sellers, tea vendors, candle merchants, spectacle makers, servants, and relatives and friends. The population of the provincial capital is swelled for the examination period by fully 50,000 strangers. While the names of the competitors are being received by the authorities, great preparations are being made in the examination hall. It is in reality a miniature city, enclosed by a lofty wall topped with prickly thorns. Coolies are employed pumping water into the great tanks, herds of pigs are stalled, and provisions in vast quantities stored. Butchers, cooks, doctors, tailors, printers, undertakers, take up their quarters in the various lodges of the examination arena. The thousands of narrow cells, about as big as horse stalls, for the candidates are cleaned for their coming inmates. The furniture is simple—a board for a seat and a sloping board for a desk.

The candidates having been identified and numbered are locked in their cells. The themes are handed out and the contest begins. For thirty-six hours, two nights and a day, the competitors address themselves to their tasks, food being brought to them at intervals. On the morning of the second day the papers are collected and the inmates of the hall go out for a day's well-earned rest. After an interval of twelve hours all are back again in their places. Doors are again locked, fresh questions handed out, and thirty-six more hours' toil follows. Again there is a break of a day, and then another, and the final spell of thirty-six hours' scribbling and thought. In these three sections the contest is comprehended. The physical and mental strain is terrible, and candidates have been known to die in their cells. The examination comprises essays on the sacred books, history, poetry, and the whole gamut of Chinese writings. . . . To prevent any suspicion of partiality in the awards, the papers of the candidates are copied out by official scribes, so that the examiners have no clew to the authorship of the essays. But the Imperial examinations are conducted with scrupulous fairness; they are about the only thing in China which is above suspicion.—Evening Standard.

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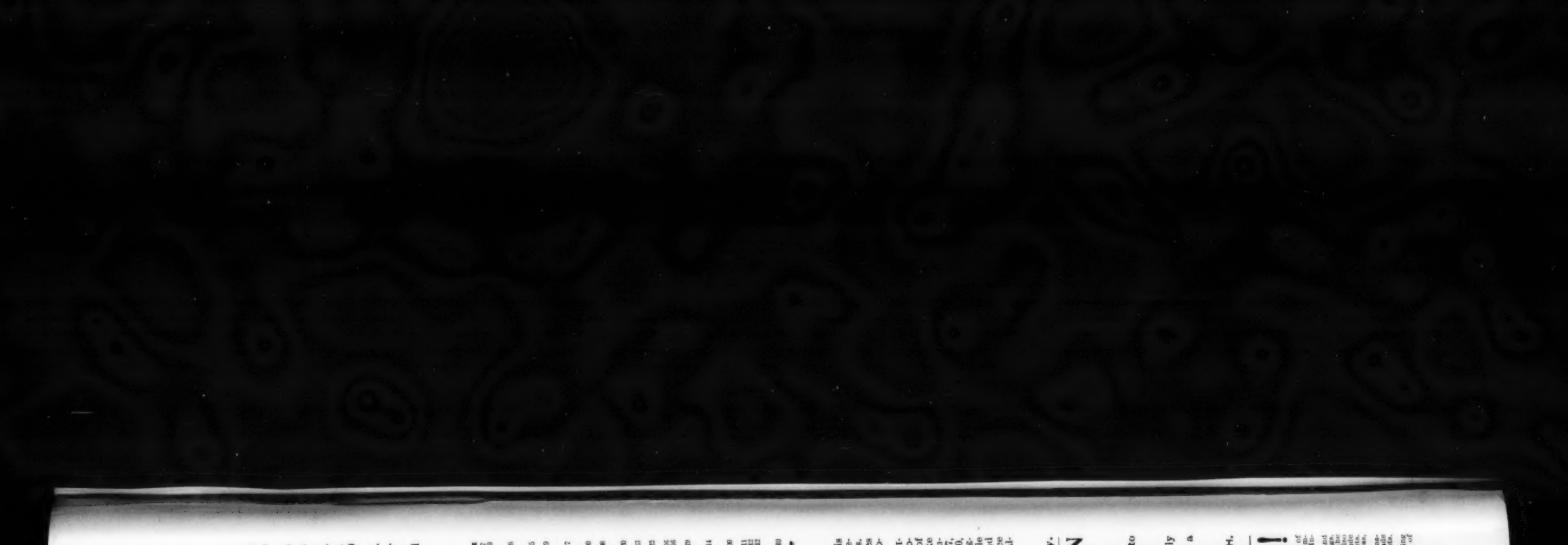
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